ARCHIVES OF OPHTHALMOLOGY.

EPITHELIAL CYST FORMATION IN THE IRIS, WITH ILLUSTRATIVE CASES.[1]

By Dr. EDWARD L. OATMAN, Brooklyn, New York,
SURGEON TO THE MANHATTAN EYE, EAR, AND THROAT HOSPITAL.

(*With eight figures on Text-plates IV.–VII.*)

EPITHELIAL cells proliferating in the iris usually result in cyst-formation. They seldom, if ever, possess the attributes characteristic of malignancy. Nevertheless, a benign growth when situated in the anterior chamber may cause destruction of the eye. Parsons, in *The Pathology of the Eye*, classifies cysts of the iris as follows: (1) *Implantation cysts*, including pearl-cysts and atheromatous cysts; (2) *Retention cysts*; (3) *Congenital cysts*; (4) *Cysts of the retinal epithelium*; (5) *Parasitic cysts*. He further defines as complex cysts those in which "not only the iris but also the cornea and anterior chamber take part." Greeff regards as true cysts only those having an epithelial lining and fluid or semi-fluid contents. Clinically, the great majority of cysts that occur in the iris have walls consisting of an external layer of compressed iris tissue and an internal layer of epithelial cells. Under the name of *epithelial cysts* it is desirable for my present purpose to include in one group all non-congenital iris cysts in which epithelium forms a component part. This will include the first group of the above classification and such complex cysts as are lined with epithelium. The other varieties of iris cysts are very rare. As they differ in their etiology from the epithelial cysts the various theories regarding their origin will

[1] Received by the Editor in February, 1906.

not be considered here. Except the pigmented cells of the pars iridica retinæ, the iris is a mesoblastic formation devoid of epithelium. Consequently, when an epithelial cyst develops in iris tissue, it is evident that the epithelium must have been introduced from without. The *method* of introduction is the subject to be discussed in the present paper.

Probably all true epithelial cysts of the iris are preceded by perforation of the cornea. Rothmund collected thirty-seven promiscuous cases of iris cysts in which he obtained clear histories of perforating wounds in 83.3%. Very rarely cyst of the iris follows ulcer of the cornea, as in a case reported by Gonella. After the cornea has been opened by accident or design, how do the epithelial cells enter the eye? The most generally accepted explanation is that of Buhl and Rothmund, namely: in consequence of a perforating wound a fragment of surface epithelium is detached, carried into the eye, and implanted in the iris. These engrafted cells proliferate and in course of time form either solid epithelial tumors or epithelial-lined cysts with fluid contents. In support of this theory extensive experiments have been undertaken by Dooremaal and many others, who have demonstrated that epithelium can be implanted upon the iris. These experiments have established a widespread belief in the Buhl–Rothmund theory of cyst development as shown by Parsons's classification, in which all cysts of epithelial origin are designated *implantation* cysts. There can be no doubt that cysts may, and occasionally do, develop in this manner, particularly those which form around cilia or contain sebaceous matter. Nevertheless, I believe the implantation method of cyst development to be very exceptional! A far more reasonable theory has been advanced to explain the presence of epithelial cells in the anterior chamber. In 1885, Stölting published two cases of true epithelial cysts of the iris. Both were preceded by perforation of the cornea with incarceration of iris in the wounds. Careful microscopic examinations were made of the entire globes. From a study of these cases Stölting drew the important conclusion that the cells from which the cysts developed were not detached from the surface and implanted in the iris, but that the sur-

face epithelium, which always proliferates and fills a corneal wound, had spread beyond the wound to the incarcerated iris. Through union of the corneal wound, the cells which had extended to the iris were cut off from the surface cells. They, however, survived, and by their subsequent proliferation formed true cysts of the iris. In other words, the epithelium had reached the iris by a process of growth and *extension* from the surface. In order to appreciate how reasonable this explanation appears, it is necessary to briefly review the principal phenomena that occur in the repair of corneal wounds, especially noting the great activity manifested by the surface epithelium in corneal regeneration. Exhaustive studies have been made on the repair of corneal wounds. Rabbits have usually been employed in experimental work. The results obtained conform in essential points with the changes observed in human eyes removed for accident or disease. An uncomplicated, incised perforation of the cornea, accompanied by loss of aqueous, is shortly followed by closure of the wound and restoration of the anterior chamber. The closure is brought about by swelling and apposition of the central lamellæ of the cornea and the formation of a fibrinous exudate which plugs the wound. Although the central layers of the cornea swell, the external and internal layers retract, thereby causing both openings of the wound to gape. The wound tract is thus separated into two V-shaped clefts, one communicating with the anterior chamber, the other opening externally. Receipt of such an injury is immediately followed by active proliferation of the corneal epithelium, which spreads down into the external division of the wound, lining its sides and covering the fibrinous exudate which remains at the bottom. This proliferation of epithelium reaches its maximum in two or three hours and is usually completed by the end of the first day (Weinstein). The epithelium remains in the wound until pushed out by regenerated corneal tissue. The posterior division of the wound becomes filled with endothelium, and union takes place by a similar but much slower process than in the anterior division. Similar phenomena occur in loss of corneal tissue without perfora-

tion. Temporary repair is effected by the epithelial cells, which multiply in sufficient numbers to fill in and level every inequality or crevice that exists. The latter process is well illustrated by the following case.

CASE 1.—The eye had been severely burned with lime. Other injuries necessitated enucleation. The microscope showed destruction of the external three-fourths of the cornea over a large area. The resulting excavation was entirely filled in with epithelial cells resting upon a bed of granulation tissue.[1] (Fig. 1.) (*From the Pathological Laboratory of the Brooklyn Eye and Ear Hospital.*)

The presence of necrosis or purulent inflammation does not inhibit the proliferative energy of the epithelium as shown by the following case.

CASE 2.—The eye was lost through panophthalmitis following cataract extraction. The photograph (Fig. 2) shows the proximal corneal flap infiltrated with pus, nevertheless the surface of the gaping wound is covered with epithelium which has extended from the surface to Descemet's membrane.[1] (*From the Pathological Laboratory of the Manhattan Eye, Ear, and Throat Hospital.*)

If from any cause a corneal perforation remains open and no obstacle is presented to the progress of the ingrowing epithelium, the latter will not confine itself to the anterior division of the wound, but spread beyond to contiguous parts. Such migration of cells may be followed by various unfortunate results: the interposition of epithelium between the wound surfaces may delay union or permanently prevent cicatrization. In the latter case a corneal fistula will be established. The cells may extend to the iris or, as in the following case, line the anterior chamber.

CASE 3.—The patient was treated by my associate, Dr. Charles Burr. A perforating wound of the cornea was received eight

[1] As the cases reported in this paper are to illustrate only an argument, irrelevant details are omitted for the sake of brevity.

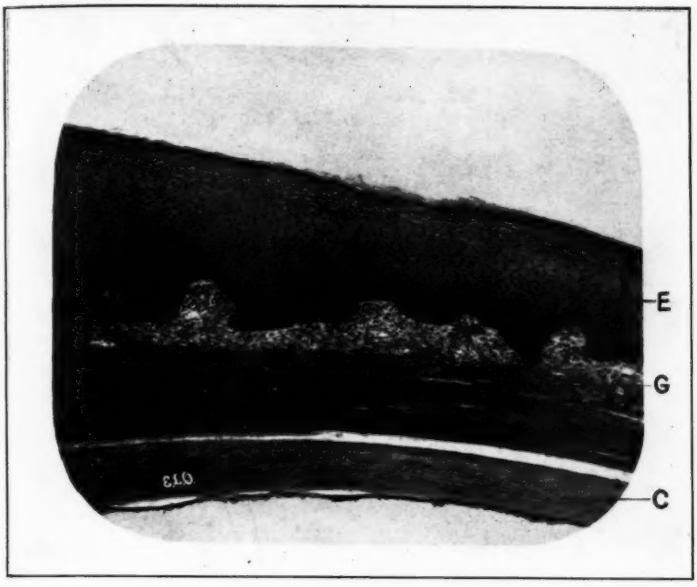

FIG. 1. Process of repair after loss of corneal tissue. Lime burn. C. Undestroyed posterior layers of cornea. G. Granulation tissue, the inner layers of which have organized into scar tissue. E. Thick layer of young epithelial cells. B. & L. Obj. 2/3. Oc. 1.

FIG. 2. Panophthalmitis following cataract extraction. Proximal flap of corneal wound infiltrated with pus. Surface epithelium has lined wound and extended to Descemet's membrane. B. & L. Obj. 2/3. Oc. 1.

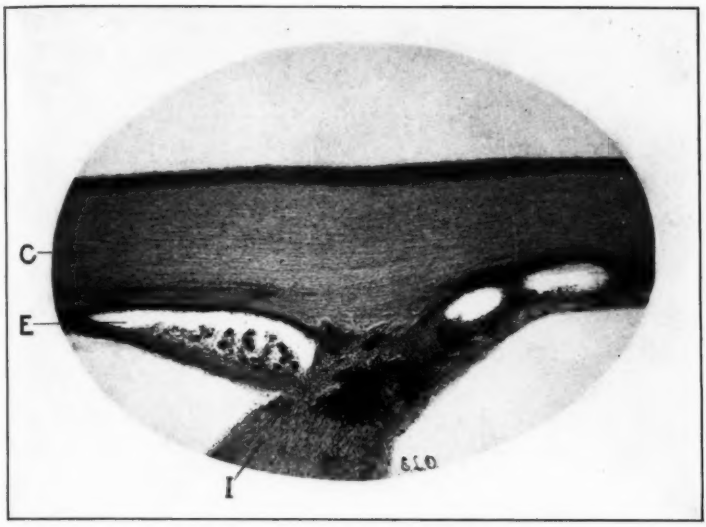

FIG. 3. Cystic and tubular spaces formed in iris and anterior chamber by proliferation of epithelium. C. Cornea. E. Epithelial cyst. I. Iris. B. & L. Obj. 2/3. Oc. 1½.

FIG. 4. Glaucoma produced by epithelium proliferating into filtration angle and obstructing outflow of aqueous from anterior chamber. S. Surface epithelium. C. Cornea. B. Ciliary body. E. Epithelium in filtration angle. B. & L. Obj. 2/3. Oc. 1.

years before enucleation. Some vision was retained for seven years, then inflammatory glaucoma developed and sight was entirely destroyed. At last the eye was enucleated to relieve the continued pain and inflammation. Microscopic examination showed anterior synechia and extensive growth of epithelium in the iris and anterior chamber. The epithelial cells were deposited in superimposed layers corresponding both in appearance and arrangement to the corneal epithelium. They had lined a large portion of the posterior surface of the cornea and also formed numerous tubular and cystic cavities in the iris and between the iris and cornea. (Fig. 3.) The immediate cause of glaucoma was an extension of the epithelial sheet into the angle of filtration, thus blocking the outflow of aqueous from the eye. (Fig. 4.) (*From the Laboratory of the Manhattan Eye, Ear, and Throat Hospital.*)

The course of events in this case may reasonably be stated as follows: perforation of the cornea followed by the usual proliferation of epithelium. Through some accident to the process of corneal regeneration no obstruction was presented to the ingress of epithelium, which intruded into the anterior chamber. Subsequent union of the corneal wound isolated these invading cells, which continued to proliferate until they destroyed the eye, as described above. Fuchs has seen four similar cases and suggests that "*this condition may sometimes be the cause of increased tension after cataract extraction.*"

Instead of spreading throughout the anterior chamber, the epithelium may be confined to spaces created by inflammatory adhesions between the iris and cornea, as illustrated by the following case.

Case 4.—Male, aged twenty-four. Six years before coming under observation the cornea was perforated by a piece of steel. The foreign body was removed immediately, and prompt union of the wound followed. The eye had been painful for the past year. He exhibited dense leucoma of the cornea. No perception of light. As pain was persistent, the eye was enucleated. The pathological examination showed total anterior synechia except at one point behind the leucoma, where a closed cavity

existed between the iris and cornea. This space was lined with epithelial cells. (Fig. 5.) (*From the Pathological Laboratory of the Manhattan Eye, Ear, and Throat Hospital.*)

Should the iris obstruct a corneal wound, the ingrowing epithelium may penetrate into its spongy tissue and form a cyst. It is impossible to state the conditions that determine extension of epithelium to an incarcerated iris. When the iris lies at the bottom of a corneal perforation, its exposed surface is covered with a layer of fibrinous lymph which protects it from contact with the epithelium. (Fig. 6.) It may be assumed that should this lymph fail to form, or be lost after its formation, the iris would thereby be deprived of its natural protection against epithelial invasion.

Proliferating epithelium confined to iris tissue usually forms a cyst. This result is not wholly due to its confinement within a circumscribed space, as non-malignant, migrant epithelium appears to possess an inherent tendency towards cyst formation.

The following case is an example of the extension method of epithelial cyst formation in the iris. The patient was treated by my associate, Dr. J. L. Barnes.

Case 5.—Woman, thirty-eight years of age. A perforating wound of the cornea was received in infancy. Some defect of the iris had been observed for many years. The eye had become blind and painful within the past year. There was a tumor in the anterior chamber in size and appearance resembling a dislocated lens. Iridectomy was performed, and an unsuccessful attempt made to remove the tumor. Its complete collapse during operation revealed its cystic character. Two weeks later the eye became hard and painful. It was then enucleated.

Pathological Examination.—In the anterior chamber are the remains of an iris cyst the walls of which are supported by iris, cornea, and lens. The cyst cavity is lined with from one to four layers of stratified epithelium. These cells are degenerated and stain but faintly with hematoxylin. Evidently the cyst developed in the stroma of the iris as a thin layer of pigment can be traced between the epithelium and surrounding tissues. The walls of the cyst were ruptured, but its removal by operation was prevented by firm and extensive adhesions to the cornea and

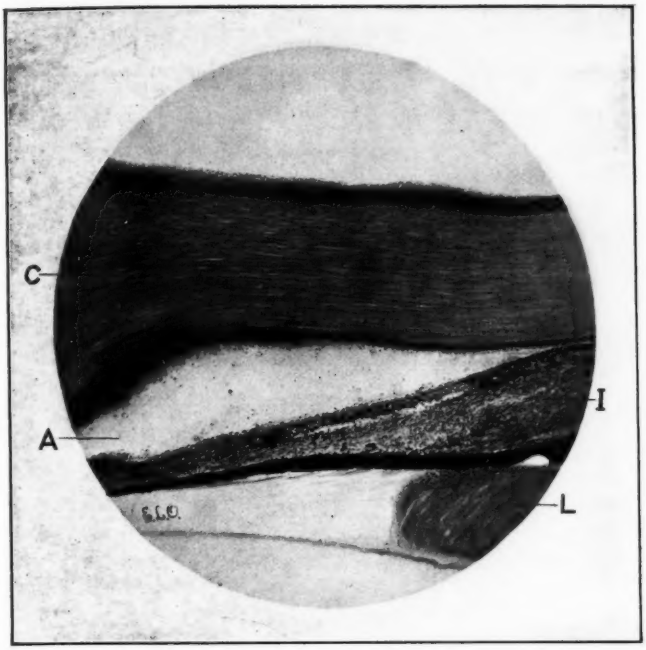

FIG. 5. Anterior chamber obliterated by inflammatory adhesions between iris and cornea except a cystic space (A) lined with epithelium. C. Cicatricial cornea. I. Iris. L. Lens matter. B. & L. Obj. 2/3. Oc. 1½.

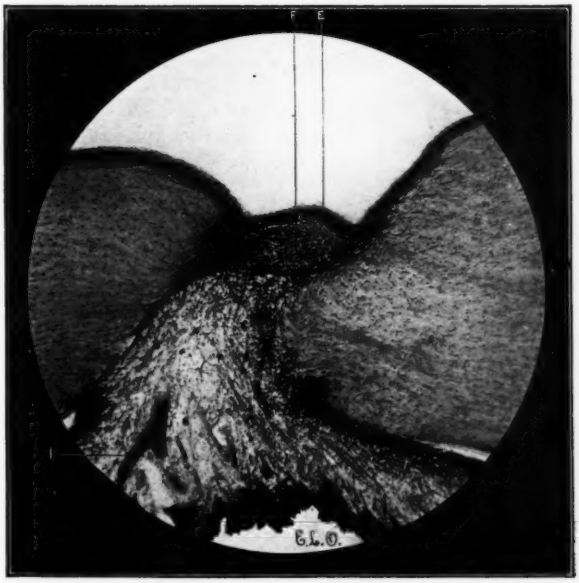

FIG. 6. Perforating wound of rabbit's cornea, 48 hours old. Prolapse of iris. I. Incarcerated iris. F. Layer of fibrinous exudate. E. Layer of new epithelium. B. & L. Obj. 2/3. Oc. 1½.

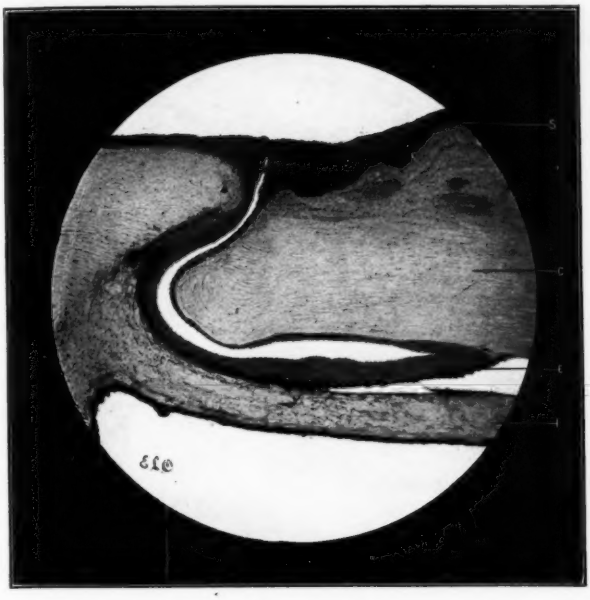

FIG. 7. Iridectomy wound two weeks old. Prolapse of iris. Epithelium has invaded iris and formed cyst. S. Surface epithelium. C. Cornea. I. Iris. E. Epithelial cyst of iris. B. & L Obj. 2/3. Oc. 2.

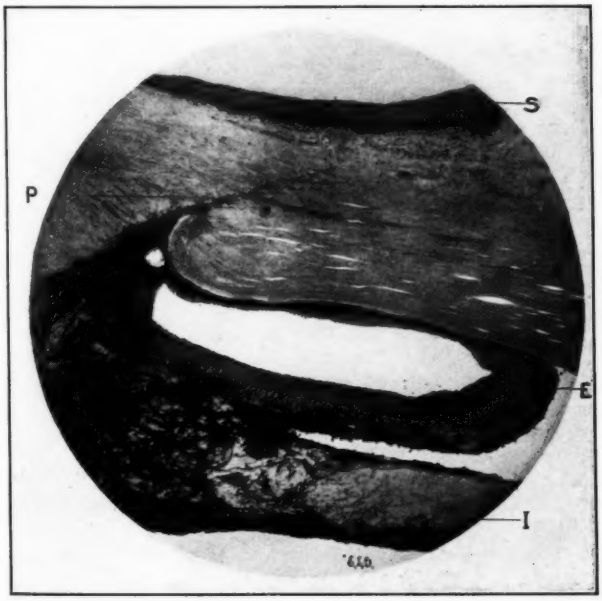

FIG. 8. Epithelial cyst formation. Continuity of ingrowing epithelium has been severed by union of corneal wound isolating cells in iris. S. Surface epithelium. P. Corneal cicatrix marking line of perforation. E. Epithelial cyst in iris. I. Iris. B. & L. Obj. 2/3. Oc. 3.

lens. This cyst was the tumor observed clinically. I shall refer to it as the *old cyst*, to distinguish it from another and more interesting cyst formation in the same eye. At the site of the recent iridectomy the iris stump is incarcerated in the wound. The corneal epithelium has proliferated into the incision as usual. Here it has encountered and penetrated into the incarcerated iris, in the tissues of which it has formed a true cyst of the iris. The cyst thus created extends into the anterior chamber, its external wall resting against the posterior surface of the cornea. Serial sections demonstrated this to be a closed cavity. Fig. 7 shows a region where only superficial closure of the wound has taken place. Here the epithelium can be traced as a continuous unbroken sheet down through the track of the wound and into the cavity of the newly created cyst. Another section from the same cyst (Fig. 8) exhibits a region where cicatrization of the cornea is nearly completed. The continuity of the ingrowing epithelium is severed, thereby isolating the cells which have invaded the iris. The cells lining the cyst are stratified epithelium, from five to fourteen layers in thickness. They are vigorous young cells, which stain deeply as contrasted with those lining the old cyst. They tend to arrange themselves as on the cornea, the basal cells being cuboidal and the superficial flattened. Cellular segmentation exists throughout the basal layer, but is more active on the inner wall, where the epithelium is most abundant. There is no true basement membrane, the epithelium everywhere resting upon iris tissue.[1] (*From the Pathological Laboratory of the Manhattan Eye, Ear, and Throat Hospital.*)

The above cases demonstrate that after perforation of the cornea the surface epithelium will spread into the anterior chamber unless some obstruction is presented to its progress. In normal repair this accident is prevented by approximation of the wound-surfaces and formation of a fibrinous plug; but when overriding flaps or other complications create a patulous wound, epithelial invasion may follow. Therefore it is not unreasonable to believe that in epithelial cysts of the iris the epithelium first enters the eye by the process of *extension*. Experimental implantation of foreign

[1] This case was exhibited by the author before the Section on Ophthalmology, N. Y. Academy of Medicine, Jan. 18, 1904.

tissue upon the iris proves nothing except that the iris is good soil for epithelial growth. This fact counts as much for the extension as for the implantation theory. It also would lead us to expect the survival of epithelium which had extended to the iris. The extension theory necessitates contact between the iris and wound. That such contact does occur appears to be true, as the majority of published cases describe adhesion of either the iris or cyst wall to the cornea.[1]

There is no proof that normal surface epithelium which has invaded the iris ever becomes malignant. In fact, it is doubtful if primary carcinoma of the iris has ever been observed. All cases reported as such have been discredited by more than one competent pathologist. The inflammatory changes excited by epithelial proliferation in the anterior chamber might produce a tissue closely resembling epithelioma.

Although Stölting's theory of cyst formation in the iris has been respectfully mentioned by writers, it has seldom been accorded the prominence to which it is entitled. One exception to this is a paper by Meller, in which he reported several cases of epithelial proliferation in the anterior chamber, and applied Stölting's theory to explain the phenomena. Another is a paper by Fuchs in which he states that "cysts of the iris occurring after penetrating wounds are always due to this form of intrusion of the external epithelium"; and again, in the last (tenth) edition of his text-book, he fully endorses the extension theory of cyst formation in the iris.

The propensity of corneal epithelium to penetrate into every accessible crevice has a very practical application in the treatment of corneal wounds, particularly cases of delayed union. It also emphasizes the well-known importance of securing accurate coaptation of flaps after operations involving corneal section.

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[1] Accurate analysis of this point was undertaken, but found to be impracticable, as so many of the cases reported were clinical observations or incompletely described.

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CASE OF MELANOSARCOMA OF THE CHOROID AND ORBIT.[1]

By Dr. EDWARD L. OATMAN, Brooklyn,

SURGEON TO THE MANHATTAN EYE, EAR, AND THROAT HOSPITAL.

(*With two figures on Text-plate VIII.*)

THE patient, a married woman, fifty-six years of age, visited my clinic December 30, 1904. Nine months before this she accidentally discovered that her right eye was blind. Seven months after this discovery it first became painful. When she appeared at the clinic the eye was in a state of advanced glaucoma and violently inflamed. Pupil small; iris atrophic and inseparably bound to the lens; lens cataractous; no reflex from the fundus; no perception of light. The left eye was normal. This history of painless loss of vision followed by rapidly progressive glaucoma, accompanied by irido-cyclitis, with no evidence of disease in the fellow eye, indicated the presence of an intraocular growth. The patient was urged to have the eye enucleated at once, but would not then consent to operation. The glaucomatous inflammation steadily increased in severity and anterior staphyloma appeared. At last, January 11, 1905, she submitted to enucleation.

The essential features of the pathological examination were as follows: The cornea exhibited pannus degenerativus; the anterior zone of the sclera contained numerous round-celled deposits of inflammatory origin; over the ciliary body was an area where almost complete absorption of the sclera had resulted in staphyloma; this ectasia contained

[1] Received by the Editor May 24, 1906.

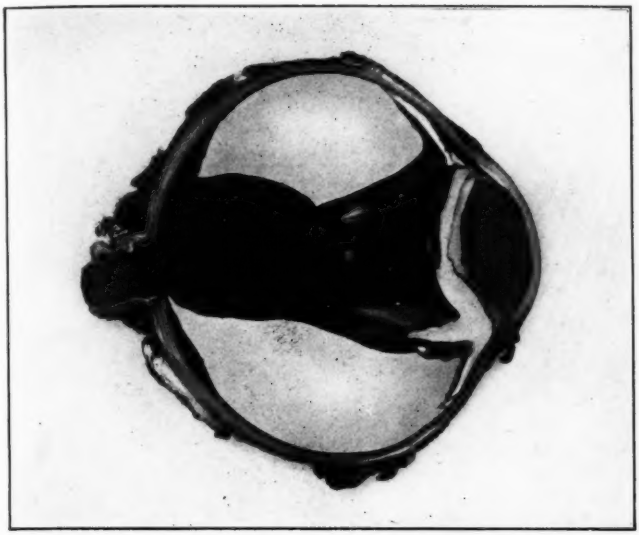


FIG. 1. Sarcoma of the choroid. The large spherical neoplasm is surrounded by a flat, circular, sarcomatous deposit.

FIG. 2. Showing extra-ocular sarcomatous deposits.

a portion of the ciliary body. The anterior chamber was represented by a thin line of coagulum; iris and ciliary body very atrophic; complete posterior synechia; lens cortex degenerated; retina totally detached. Springing from the choroid, close to the optic nerve, was a melanosarcoma, spherical in form, measuring 10*mm* in diameter (Fig. 1). The tumor was surrounded by a flat, circular, sarcomatous infiltration of the choroid and suprachoroidæ 20*mm* in diameter. Two small extraocular deposits were found (Fig. 2). The first, spherical in form, 1*mm* in diameter, was situated within the sheaths of the optic nerve, in the angle formed by the junction of the nerve and sclera; the second, situated on the external surface of the sclera close to the optic nerve, had a long diameter of 2*mm*. Both nerve and sclera were invaded by these deposits. Histologically the neoplasm was a mixed round- and oval-celled sarcoma moderately pigmented. It contained numerous large, thin-walled blood channels. The operation wound healed kindly with the exception of an exuberant granulation over the site of the optic nerve, which recurred after removal. The existence of extraocular sarcomatous deposits rendered it certain that invasion of the orbital tissues had already taken place. On March 22d the orbital contents were removed. The periosteum was not disturbed because the secondary deposits were believed to be recent and limited to the neighborhood of the optic nerve. Microscopical examination of the tissues removed from the orbit revealed several sarcomatous deposits, composed of round and spindle cells, some of which were pigmented. A few isolated, pigmented, spindle cells were found in the lymph space surrounding the optic nerve. In order to afford the patient every possible chance to recover, she was placed under the care of Dr. Wm. J. Morton, at the Post-Graduate Hospital, where X-ray was applied to the orbit every other day for four months.

The object of this report is to assist us in our prognosis of cases in which sarcoma of the choroid has invaded the orbit. Extraocular extension of choroidal sarcoma is an occurrence of extreme gravity. If malignant elements have migrated

beyond the bony walls of the orbit, they probably are inaccessible to the surgeon. In such cases, operative interference appears to excite increased proliferative energy in the sarcomatous deposits. It is therefore of the utmost importance to operate while the morbid process is still confined to the orbital tissues. In the above case the extrabulbar extension was along the course of the optic nerve. Migrating sarcoma cells were found in the intervaginal space surrounding the section of nerve removed at the second operation. As this space is in direct communication with the cerebral cavity, it was considered more than probable that tumor elements had already passed beyond the optic foramen. One year and a half has now passed since enucleation. So far she has manifested no symptoms of local recurrence or metastatic deposits. Although it is too soon to feel confident of her safety, it is probable that if further extension had taken place along the route of the optic nerve, cerebral symptoms would have indicated the fact before this time. All the extraocular deposits were small. The one situated within the sheaths of the optic nerve would have been discovered only with the microscope. Had they been overlooked, the patient's only chance for life would have disappeared.

TRAUMATIC LACERATION OF THE INFERIOR RECTUS MUSCLE.

By H. MOULTON, B.S., M.D., Fort Smith, Ark.

Oct. 19, 1904, Mr. H—, aged fifty-seven, came to me stating that three weeks before, while riding, he was struck in the face by the limb of a tree and knocked from his horse, receiving a deep wound under the right eyeball, inside the lower lid. The face otherwise was merely bruised and scratched. In falling, the back of his head struck the ground and rendered him unconscious for some moments. At the time he came to me, his recovery had been complete, except that his right eye was turned upward, and he had double vision.

Status Præsens: The right eyeball is more protuberant than the left by *2mm.* It deviates upward 30° and outward 10° as measured by the perimeter. In the middle of the lower *cul-de-sac* is a rough scar occupying two-thirds of the space between the two canthi. The appearance is as if the lower bulbar conjunctiva and underlying tissues had been stripped from the globe and pushed under it and had there cicatrized, thus deepening the *cul-de-sac* to about twice its usual depth. Voluntary downward rotation was impossible. Vision = $\frac{20}{60}$, although there were no lesions of the media or fundus.

Operation.—Jan. 30, 1905, four months after the accident, the scar was dissected free from all attachments and adhesions to the globe. The inferior rectus was found attached to the deeper portion of the scar tissue. A single suture armed with a needle at each end was employed to advance the tendon and overlying tissues after the manner employed by Beard in his advancement operation. Tenotomy of the superior rectus was then done and

the eye bandaged. The final result of the operation is that the patient has comfortable binocular single vision within an arc of 10° above and 10° below the horizontal plane, with vision of $\frac{6}{6}$ in each eye. The proptosis still remains.

It is interesting to note the improvement of vision in the eye after operation. Is it possible to account for the previous poor vision by the four months' disuse of the eye and that it was a case of commencing amblyopia ex anopsia?

Charles Stedman Bull, writing in Norris and Oliver's *System of Diseases of the Eye*, vol. iii., page 20, says: "The ocular muscles are sometimes injured without any accompanying luxation of the eyeball; but these accidents are very rare, not more than twelve or fifteen having been reported. The internal rectus is the most frequently injured." In the limited literature at my command I have been able to find twelve cases of traumatic laceration of the extrinsic ocular muscles reported by seven authors. The most frequently injured muscle was the superior rectus five times (which is in opposition to Bull's experience just quoted), the inferior rectus twice, the internal rectus four times, and the external rectus once.

In most of these cases the function of the muscle was restored by operation, but Fejér (1) reports a case in which the muscle became reunited to its proper position spontaneously, and hence concludes that it is not always necessary to suture the cut ends of the muscle in these cases. This, however, does not appeal to one as rational teaching. In my case, it is probable that a replacement of the muscle immediately after the injury would have given a better result than the late operation. Panas (3), after reporting three cases, relates his experiments on the cadaver and animals. He has never been able to tear a tendon from the eyeball but only to rupture the belly of the muscle; and concludes that in order that the tendon be torn the muscle must be in a state of tension. Dimmer (2) reports some cases in which, in addition to direct injury to an internus or inferior rectus, there was at the same time an indirect injury to the levator and superior rectus, probably due to the pressure of the eyeball upward against these muscles. With this exception the injuries were all direct, caused by some blunt or sharp object, as a piece of iron or wood or a cow's horn, etc., penetrating the orbit and thus reaching the muscle or its tendon.

The twelve cases of direct injury are reported as follows :

1 Fejér—*Arch. f. Augenheilk.*, xlviii., 264, one case.
2 Dimmer—*Zeitschr. f. Augenheilk.*, ix., 327, two cases.
3 Panas—*Arch. a'ophtal.*, xxii.-iv., 229, three cases.
4 McAchran—*Am. Jl. Oph.*, vii., 364, one case.
5 Viciano—*Arch. d'opht.*, 1889, No. 6, 508, three cases.
6 Vinsonhaler—*Annals of Ophthal.*, Apr., 1905, one case.
7 Kempner—*Klin. Monatsbl. f. Augenh.*, Feb., 1903, one case.

A CASE OF ORBITAL ENDOTHELIOMA.

RADICAL OPERATION AT THE NEW YORK OPHTHALMIC AND AURAL INSTITUTE, BY DR. HERMAN KNAPP. NO RECURRENCE AFTER TWENTY-SIX YEARS.

REPORTED BY DR. JAMES M. COOPER, OF DETROIT, MICH., HOUSE SURGEON.

ALTHOUGH the following case has been already mentioned several times in ophthalmic literature,[1] it has never before been published in full, and inasmuch as it presents several interesting and perhaps unusual features, the writer wishes to place it on record in order that it may be available to any one compiling statistics of orbital neoplasms. It is seldom that a case of this character can be kept under observation for a period of twenty-six years, and the opportunity thus afforded in the present instance is without doubt of considerable value. The patient, who has been in the habit of presenting himself for examination about once a year, was seen by the writer a few weeks ago, and it is from this examination, and from the records of the New York Ophthalmic and Aural Institute, and from a microscopical examination of the growth itself, which was found preserved in the laboratory, that this paper has been prepared. I am under obligations to Dr. Herman Knapp, who drew my attention to the case and asked me to search for the specimen and describe it for publication.

[1] Knapp, Discussion at American Ophthalmological Society. Ring, *N. Y. Medical Journal*, June 10, 1905.

The patient, A. S., aged twenty-four, was admitted to the hospital on March 30, 1880, presenting a new growth in the left orbit, and giving the following history: He first noticed trouble with his eye a year and a half previously, and refers the commencement of his disease to a particular date upon which he was struck in the eye by several cinders, which lodged in the conjunctiva of the lower lid, and one of which, patient is certain, was never removed. The eye was red and sore for a long time, and after some months the pain became more intense, being of a throbbing character, and situated in the globe, orbit, brow, and temple by turn. The tumor began to be palpable about six months before his admission to the hospital and was then located in the floor of the orbit. It rapidly increased in size, extending forward beneath the conjunctiva—pushing the globe upward and inward—and by attachments to it restricting its movements in all directions. Pain was now constant and of a dull, throbbing character.

Examination showed the presence of a firm tumor-mass beneath the skin, in the lower and outer part of the left orbit, displacing the globe and rendering it stationary by numerous adhesions. Palpation demonstrated the mass to be immovable, hard, and attached to the orbital walls, evidently extending far back into the orbit, but seeming—in its outer parts, at least—to be encapsulated and not to infiltrate the surrounding tissues. Vision O. D. $\frac{20}{20}$, latent hyperopia; O. S. $\frac{20}{200}$, not improved by lenses. Patient had not, however, noticed any diminution in visual acuteness; and states that he had been operated upon when a child for convergent squint, and that he had never been able to see well with the left eye. No murmur could be heard upon stethoscopic examination and the growth did not pulsate. The preauricular and cervical lymph-glands were not involved.

The family history was negative as regards the subject in question, and the patient himself was otherwise in perfect health.

Diagnosis of orbital sarcoma was made and enucleation of the growth advised. The operation was performed by Dr. Herman Knapp, and is described in the records as follows:

"An incision was made along the lower edge of the orbit, and the skin and subcutaneous tissues retracted until the tumor was exposed to view. When this was reached it was

detached above and on the sides from the surrounding tissues, it being encapsulated and well defined in these parts. At the lower and outer part of the globe the tumor and eyeball were adherent and had to be separated—the inferior oblique muscle, which was exposed, being spared. The growth extended far back into the orbit, but was easily detached above from the orbital tissues beyond the posterior surface of the globe. The firm attachment to the floor of the orbit required the use of scissors and chisel to break it up; but finally the periosteum was detached as far back as the growth extended. After cutting the posterior attachments, it was found that a portion of the optic nerve, one-half inch in length, had been removed with the growth, which had involved the sheath of the nerve. Before the main mass of the tumor had been removed, copious hemorrhage ensued in the depths of the orbit, probably from division of the ophthalmic artery. A few small pieces of the tumor on the sides and at the apex of the orbit were then removed, the whole being accomplished without injury to the globe. After the hemorrhage had been controlled the wound was united and a pressure bandage applied."

Contrary to expectations, the wound did not unite by first intention, but discharged freely both through wound and through an opening made in the conjunctiva below the eyeball. On account of the section of nerves and blood-vessels, the cornea was rendered insensible, and its nutrition interfered with. A large and deep corneal ulcer subsequently developed, which complicated the healing process and prolonged the patient's stay in the hospital. An interesting note of the fundus examination, made a week after the operation, is as follows: "Media clear. Retina milky white. Vessels appear as dark streaks. No cherry-red spot at macula, but otherwise the picture of retinal embolism." The corneal ulcer began to develop about two weeks after the operation, its acute stage lasting about two weeks. Patient was discharged May 3, 1880, thirty-four days after his admission.

He was next seen on June 6, 1880, at which time the following note was appended to the record: "Globe attached to scar; not movable. Corneal opacity clearing."

Since his recovery from the operation performed twenty-six years ago, patient has had no trouble in the way of pain, swelling, or inflammation in the globe or orbit. He has presented himself at intervals of from twelve to eighteen months for inspec-

tion, and there has never been at any time the slightest sign of a local or metastatic recurrence. He was examined by the writer in January, 1906, and the following conditions were found: Globe shrunken and hard. Immovable from attachments to orbital walls. The cornea is opaque; V = 0. He has never been able to wear an artificial eye with comfort, chiefly on account of the absolute immobility of the stump, which causes the conjunctival secretions to collect and harden in a horizontal line opposite the palpebral fissure.

After seeing the patient and referring to the hospital records in his case, a search was made for the tumor among the pathological specimens preserved in the laboratory. It was found, almost entire, in 80 % alcohol. The part containing the piece of optic nerve had been cut away, except for a small portion of its sheath, and could not be found. The part left, which comprised practically the whole tumor, was of a roughly pyramidal shape, about 50*mm* long and 20–30*mm* in diameter at its base. It was firm in consistence and sections are seen to contain numerous trabeculæ of connective tissue extending inward from a well-marked capsule above and on the inner and outer side. Below the capsule is absent. At one point the tumor mass appears on both sides of its capsule, and *in this extra-capsular portion of the growth is found its most typical structure, this being an area of active proliferation. Sections were cut from several parts of the growth in such a manner as to include the capsule and tumor mass to its centre. The extra-capsular portion was sectioned by itself.*

In this extra-capsular part are found masses and clumps of large oval cells, with large faintly staining nucleoli lying loosely packed in spaces and clefts of newly formed connective tissue. In the trabeculæ of connective tissue are numerous small blood-vessels consisting only of a single layer of endothelial cells. Blood cells are also found in spaces of the tissue which have no recognizable endothelial lining. Karyokinetic figures are occasionally recognizable.

Other (intracapsular) portions of the tumor mass show such a variety of structure that, if only single sections from

various localities were considered, a variety of diagnoses would result. In general, the cells are more densely crowded together and the trabeculæ of connective tissue either pushed aside or covered over, *the tumor appearing as a round-cell sarcoma. In still other places the cells take on a spindle shape*, being held together by a fine hyaline intercellular substance. In these portions all traces of lymph spaces are lost, and even the blood-vessels have normally thick walls. No pigment is found in any portion of the tumor.

The capsule consists, for the most part, of dense hyaline tissue having few nuclei and blood-vessels. In portions of the growth which came from the apex of the orbit numerous corpora amylacea are found, but no other trace of nerve tissue is present. These are situated mainly along the course of a large trabecula of connective tissue extending into the growth,—and also in the neighboring capsule.

From the foregoing description, it appears that the cells—especially in the spreading portion of the growth—are distinctly endothelial in type, and the tumor itself may be regarded as primarily a proliferation of the endothelial cells of the orbital lymph vessels or capillaries. In the older and denser portions, the picture is that of a round- or spindle-cell sarcoma; and indeed it is not impossible that such areas represent a transition process into such a growth.

In comparing the tumor with endotheliomata found in other parts of the body, the absence in the present case of a tendency to colloid, hyaline, or myxomatous degeneration is striking. The corpora amylacea mentioned as being found near the apex of the growth may have come from the sheath of the optic nerve, of which they are an occasional, if not a normal, constituent. The fact that the radical operation completely eliminated the growth, confirms the frequently mentioned observation that orbital endotheliomata, while locally malignant, do not tend to form metastases, and that their complete removal may be confidently expected to result in a cure.

GLIOMA OF THE RETINA. REPORTS OF FOUR CASES.

By Dr. S. C. AYRES, Cincinnati, O.

(*With two illustrations on copper-plate.*)

Case 1.—Female, two and one-half years of age. Was first seen March 3, 1892. The child had a neoplasm in the left eye, which was discovered only recently. It presented a rounded appearance and was located in the upper and posterior portion of the globe. It was slightly vascular but did not present the typical appearance of a glioma. In order to clear up the diagnosis, I allowed the father to take the girl home for a few weeks. He returned about six weeks later in April, and there was noticed a decided change in its appearance. The tumor had advanced to the cornea and now quite filled the globe. It also had the characteristic yellowish reflex. Immediate enucleation was recommended and done. The microscopic examination of the eye revealed a glioma in the active stage of advancement.

In the *Transactions of the American Medical Association*, for 1902, Dr. C. R. Holmes reported this case, together with some others, as he was a consultant in the case.

Case 2.—Female, twenty-two months, was first examined May 19, 1898. The left eye was blind and had been so probably for several months. Inspection revealed a neoplasm growing from the fundus and coming forward to the lens. It was yellowish in color and had developed in irregular masses. The pupil was dilated and the corneal diameter was slightly above normal. Tension was + 1, but there was no evidence that the eye had ever been painful. The ophthalmoscopic appearance was so characteristic that immediate enucleation was advised and the operation done at once. The tumor was examined microscopi-

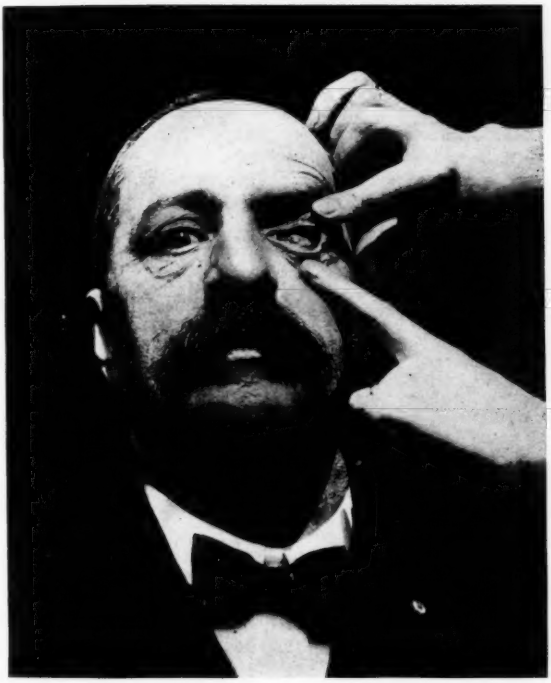
cally and found to be a glioma, the characteristic growth and development being present. I have seen the patient at intervals since then, and the last time was November 3, 1905. There has been no return of the growth in the orbit, and she wears an artificial eye and has done so for two years. It is now about eight years since the excision of the eye and the girl is in excellent health.

CASE 3.—Female, two and one-half years old. Was examined February 5, 1900. The right eye was nearly filled with a tumor which presented all the characteristics of a glioma. It came forward almost in contact with the lens; in the outer side it is lobulated, and its surface is vascular. The pupil is dilated, tension + 1, and iris discolored. Immediate enucleation was recommended and done very promptly at the child's home. The father wrote me recently that the child died about two weeks after the enucleation. She had a spasm and became unconscious. This points directly to an extension into the brain. I am unable to get any record of the microscopic examination of the eye, but the macroscopic appearance and the early death lead me to conclude that it must have been a glioma.

CASE 4.—Female, twenty months old. Was referred to me by Dr. J. A. Thompson. The child was well grown and presented a healthy appearance. About eight months ago, a peculiar reflex was noticed from the left eye. It did not excite any alarm at first, but as it continued to increase, an oculist in Chicago was consulted, who made a correct diagnosis. When I first saw her, October 3, 1905, the ophthalmoscope revealed a tumor on the inner side of the globe, which extended forward almost to the lens. It was rather flat and broad and presented the typical color of a glioma, but was not very vascular. A red reflex could be seen on the temporal side of the globe. The tension was normal, the pupil responsive, and iris not discolored. Enucleation was done at once. It is now two and one-half years since the operation. She is in excellent health, is growing and developing normally. There has been no return of the growth up to the present time.

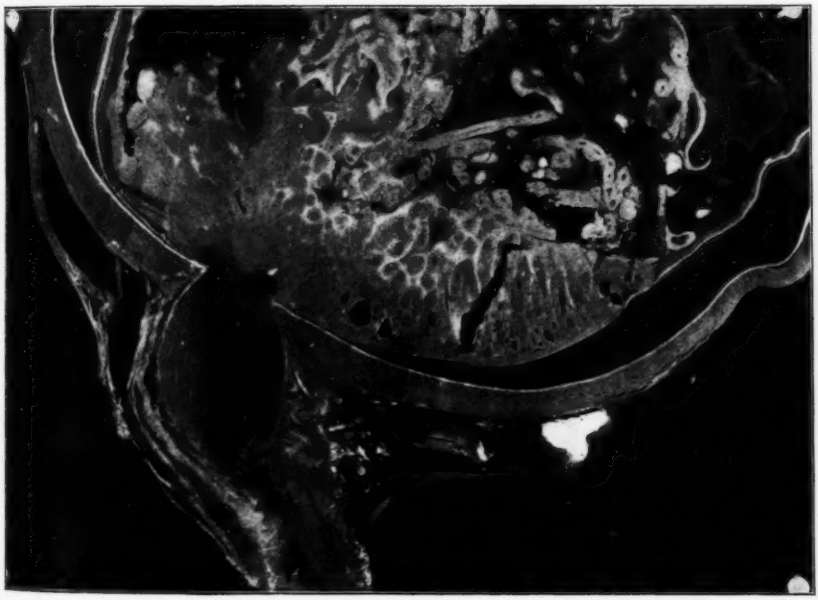
Section of the globe shows a round, grayish-white tumor-mass, filling the posterior half of the eye. Its anterior surface projects to within 3*mm* of the posterior surface of the lens. The cornea, anterior chamber, iris, and lens present no pathological conditions, and the iris angle appears normal. Microscopically it

ILLUSTRATING A CASE OF ORBITAL ENDOTHELIOMA.



Endothelioma of orbit in transition into sarcoma. Removed radically by Dr. H. Knapp, twenty-six years ago. No relapse at any time. Patient has been well.

CASE NO. II ILLUSTRATION NO. 1



CASE NO. IV. ILLUSTRATION NO. 2.

presents a well-marked tubular appearance. Owing to the early removal, the subretinal space is entirely uninvolved, and there are very few areas of degeneration. There is an intense neuritis, the disk projecting out into the tumor. Marked congestion is observed and infiltration by glioma and leucocytes throughout the nerve as far as can be seen, infiltration being specially marked at a point just within the ora serrata, where the mass of glioma cells is so dense it might be considered a new focus. From sections made, its apparent origin is from the inner granular layer.

Of these four cases, two were two and one-half years of age, one was one year and ten months, and one one year and eight months of age.

Mr. C. Devereux Marshall states that the statistics of the Moorfields Hospital show that about 60 % of the cases of glioma occur in the first two years of life, and that about 80 % occur during the first three years. This coincides very nearly with the observation of Wintersteiner, who collected the large number of 467 cases, and found that 75 % occurred within the first three years.

With regard to sex, it is rather a coincidence that my cases were all females. In general the disease is about equally divided between the sexes.

Case No. 1 is now fourteen years of age and in good health.

Case No. 2 is now eight years of age and in excellent health.

Case No. 4 is now two and one-half years old, and bids fair to pass the three years' limit of immunity. A letter received from the father says "she is perfectly well."

Mr. E. Treacher Collins, in volume xiii., R. L. O. R., reviews the results in sixty-six cases of glioma of the retina, occurring in sixty patients. After giving the sex and age of the patients, he refers to the number of recoveries. Only those are considered to have recovered who have had no return of the disease for a period of three years. Among the cases above considered, which were operated on in the Moorfields Hospital during the years from 1871 to 1890,

there were eight recoveries. The time which had elapsed since operation varied from three years to nineteen.

Six more cases were known to be alive, but as they had not reached the three years' limit they are not considered.

Mr. Collins also appends a list of twenty-five successful cases occurring in the hands of various oculists, among them Brudinell Carter, Hirschberg, Knapp, Agnew, Lawson, Noyes, Lukowicz, and others.

In vol. xiv. R. L. O. R., Mr. C. Devereux Marshall continues the report of Mr. Collins on the subject of glioma occurring from 1890 to 1897. There were 32 cases: of these there were 15 which had exceeded the 3-year limit, the time running from 3 years and 4 months to 6 years and 9 months. These cases include five cases where both eyes were removed. In the first series reported there were two cases of recovery after double enucleation.

In studying the statistics of 467 cases as described by Wintersteiner, we find that about 49 % occur in the first two years of life; 67 % in the first three years—these include the congenital cases, which constitute about 7 % of the entire number. It is possible that the congenital cases are more numerous than these statistics show. A baby's eyes are not closely inspected, providing there is no external evidence of inflammation. The neoplasm grows until it produces a reflex which is noticeable, and by this time it may have been developing for a few months. It is a curious thing that in some cases a visiting neighbor is the first to detect the defect. She comes in and inspects the baby critically, and of course takes it to the light where the reflex is seen for the first time.

An ophthalmoscopic examination is the only thing which would reveal the earliest stages.

ON PIGMENTATION OF THE RETINA AFTER OPTICO-CILIARY NEURECTOMY IN MAN.

By Dr. THEODOR F. STUDER,

ASSISTANT IN THE BERNE UNIVERSITY EYE CLINIC.

Abridged Translation from the German Edition, Vol. LIII., 1905 by Dr. WARD A. HOLDEN.

(*With eight appended plates.*)

WAGENMANN'S paper, "Experimental Investigations on the Influence of the Retinal and Choroidal Circulation on the Nutrition of the Eye and the Results of Section of the Optic Nerve," *Graefe's Arch.*, 36, 1, contained the first systematic and methodical study of the cause of the changes in the pigment epithelium of the retina and the proof of the dependence of the epithelial changes upon morbid changes in the pigment epithelium.

Wagenmann's investigations concerned the rabbit's eye alone, and it is interesting to show by the examination of human eyes that his results have general applicability. Through the kindness of Prof. Siegrist I had the opportunity of examining an eye enucleated three weeks after an optico-ciliary neurectomy.

Elise B., aged twenty-four, had a miscarriage after a fall in the autumn of 1898. Ten days later the vision of the right eye became cloudy. In the middle of July she came to the clinic with a uveitic cataract in the right eye, with good projection of light.

In October a posterior cortical cataract had developed in the left eye.

February 22, 1899, an extraction with iridectomy was made in the right eye. Later the cataract in the left eye was extracted. The left remained free from irritation, but the right later became painful with swelling of the iris and high tension. Repeated attacks of glaucoma followed in the right eye and on February 3, 1900, optico-ciliary neurectomy was done. A vertical cut was made in the conjunctiva near the attachment of the external rectus. The muscle was fixed in a double hook and divided some millimetres from the ball. The optic nerve was then cut with scissors and the eyeball fully everted and all the ciliary vessels divided. After checking the hemorrhage, the external rectus was sutured and the conjunctival wound closed.

After the operation there were some exophthalmos and chemosis of the conjunctiva, a defect in the corneal epithelium where it was exposed by the incomplete closure of the lids, hypopyon, and cloudiness of the lower portion of the cornea; + T. The hypopyon became absorbed, but hemorrhage took place into the anterior chamber. The pain returned and on February 24th the eye was enucleated.

The ball was fixed in formol, imbedded in celloidin, and cut from above downward in serial sections.

ANATOMICAL EXAMINATION.

Conjunctiva.—Marked swelling of the bulbar conjunctiva, dilatation of the episcleral vessels, and exudation of leucocytes, many of them collected in groups and some breaking through the epithelium.

Cornea.—Almost normal conditions were found in the upper fourth of the cornea. In the centre of the cornea, epithelium and Bowman's membranes were wanting. On the temporal side the root of the iris was adherent to the cornea. In the stroma of the cornea there is an increase in the corneal corpuscles, more marked in the centre of the cornea, while near the limbus there is an infiltration with round cells and many new vessels are present.

The anterior chamber below contains great numbers of red blood corpuscles and some pus cells, lying mostly upon the posterior surface of the cornea where the endothelium is in part absent and in part increased by proliferation. In the

lowest portion of the cornea, the closely adherent hypopyon appears to have broken through Descemet's membrane and to have spread out diffusely in the stroma of the cornea.

Sclera.—In the nasal side of the sclera there is a moderate round-celled infiltration, and in the temporal side, near the attachment of the divided external rectus, there is some granulation tissue.

Ciliary Body, Iris, and Angle of the Anterior Chamber (Fig. 1).—The ciliary body, with its processes, is very much atrophied, measuring at the most one-quarter of its normal thickness, and is pressed forward toward the deep anterior chamber. The depth in the chamber is 3.5*mm.* Of the ciliary muscle only some flattened meridional fibres are to be distinguished, while the remainder of the ciliary body is closely infiltrated with round cells.

The iris is somewhat atrophic and infiltrated with round cells, particularly at its pupillary and ciliary margins. At the pupillary margin a cellular scar tissue unites the iris with the underlying remains of the lens capsule, within which are some cortical masses.

The root of the iris is adherent to the cornea for a short distance on the temporal side, blocking the ligamentum pectinatum and the passages to the canal of Schlemm, which is dilated and filled with blood.

On the nasal side, the iris in its ciliary half, which is thin and atrophied, is adherent to the posterior surface of the cornea. In the new-formed angle of the anterior chamber is blood, which extends in a thin layer over almost the entire anterior surface of the iris.

Similar conditions are found in the entire series of sections through the iris. Upward is a coloboma, but the channels of exit, toward Schlemm's canal, had not been opened by the iridectomy.

Retina and Choroid (Fig. 2).—A deep excavation in the disk is filled with blood. The retina and choroid immediately about the disk are completely atrophied. When examined superficially the retina and choroid in the nasal half of the eye appear normal, but marked changes are seen in the temporal half (upper portion of Fig. 2).

The nasal half of the retina has an average thickness of 0.168*mm.* The different layers can be clearly distinguished and, excepting for slight changes in the pigment epithelium, diminution in the number of rods and cones, and replacing of the ganglion cells and nerve fibres by hypertrophied supporting tissue, the retina as a whole is normal. But there are a few small areas (one is shown in Fig. 3) in which the retina is thinned and its layers are unrecognizable. The composition of these areas is a dense fibrous tissue in which Müller's supporting fibres are still present and a number of spindle cells run in the plane of the retina. The marked feature of these 1–2*mm* areas is the presence of proliferated pigment epithelium extending through the entire thickness of the degenerated retina.

The larger arteries have sclerosed walls and the small twigs have disappeared.

The choroid is somewhat thinned on the nasal side, measuring on an average 0.018–0.02*mm.* It is characterized by its great richness in long, spindle-shaped pigment cells. Besides these its component cells are long, rod-shaped cells surrounding the larger vessels which are not distended. The lamina vitrea is preserved, but there is only an indication of the choriocapillaris here and there. No inflammatory changes are present. Toward the disk the choroid is thicker and the vessels are more numerous and are also hyperæmic, and the choriocapillaris is better developed.

The portions of the choroid adjacent to the areas of pigmented retina show either a complete absence of vessels, being composed exclusively of spindle cells with infiltration of leucocytes, or there are hyperæmic vessels present.

As stated before, the most marked and extensive changes are found in the choroid and retina of the temporal half of the ball (Fig. 2 above). The thickness of the retina is reduced to 0.048–0.06*mm*, and its characteristic structure is entirely gone. It is composed entirely of an almost homogeneous connective tissue with some fibres running in the plane of the retina. In this tissue there are many cavities and scattered round and ellipsoid nuclei. Leucocytes, are

not present. The limitans interna is intact. The striking feature is the intense pigmentation of the entire temporal portion of the retina.

Several degrees of development can be distinguished in this proliferation of pigment cells. In Fig. 4 masses of pigment are seen on the lamina vitrea four to eight times the size of normal pigment epithelial cells. These are arranged like the pigment epithelial cells, but there are breaks in the row. At other points (Fig. 5) there are clefts between the choroid and retina in which are rows of cubical or globular cells detached from their natural base, the lamina vitrea. At still other points (Fig. 6) the pigment massses are arranged in several layers between the choroid and retina. In the greater part of the temporal half of the retina, however, these pigment masses of irregular form and inconstant arrangement (Fig. 7) have wandered into the completely atrophic retina, and besides these large masses are small free groups of fuchsin bodies of granular or rod-shaped form. No leucocytes are present.

Within each pigment mass a nucleus was always present, though often this could not be seen until partial depigmentation of the section had been obtained by Alfieri's method.

The choroid in its temporal half exhibits hyperæmia of the vessels and considerable thickening. On an average it measures 0.052–0.066*mm*, but at some points it is greatly reduced. Besides the hyperæmia and thickening of the choroid there are extensive extravasations of blood. Thus in Figs 5, 6, and 8 almost the entire substance of the choroid is seen to be occupied with discolored and compressed red corpuscles. Here and there, however, the choroid is almost free from vessels and is composed of spindle cells.

It is worthy of note that at certain points in the choroid, and particularly where the extravasations of blood are most pronounced, large masses of pigment similar to those in the retina are found in the stroma of the choroid.

Vitreous.—The vitreous exhibits no particular changes, but at the posterior pole of the eye it is separated from the retina by a layer of blood 1*mm* thick.

EPICRITICAL REMARKS.

The clinical history and the anatomical examination show that this case was one of chronic iridocyclitis, which had led to nutritive disturbances in the lens and later to glaucoma. The glaucoma can be explained by the adhesion between the root of the iris and the cornea, which blocked the channels of exit from the anterior chamber.

The continuance of the increased tension after the iridectomy is explained by the facts, first, that the root of the iris was adherent to the cornea and could not be entirely removed, and, second, that portions of the capsule of the lens, including proliferated capsular epithelium, became adherent to the stump of the iris (Fig. 1), and thus the channels of exit from the anterior chamber became more completely blocked than before.

The evidences of a progressive glaucoma which did not yield to the use of myotics led to optico-ciliary resection, which three weeks later had to be followed by enucleation.

The corneal changes with the hyphæma and the hypopyon were due in part to the iridocyclitis and in part to the mechanical lesions occurring during or after the resection.

One cannot say with certainty how much the corneal changes were due to the division of all the posterior ciliary vessels, but in other cases that have been studied no corneal changes followed the operation. The fact that in our case many more leucocytes had wandered from the nasal limbus into the parenchyma of the cornea than from the temporal is explained, not so much by the division of the posterior ciliary vessels as by the simultaneous division of the anterior ciliary vessels on the temporal side, so that the source of leucocytes was on this side cut off.

On and about the sclera to the outer side of the ball is a vascular tissue with epithelioid and many giant cells not of a tuberculous nature.

Also about the divided optic nerve at the posterior pole of the eye there is a dense vascular granulation tissue as a result of the operative procedure. The disk itself is deeply excavated.

In the following paragraphs attention will be directed entirely to the changes in the retina and choroid.

Fig. 2 shows how the retina on the temporal side has become thinned, and has lost its characteristic structure and has been invaded with pigment cells, while the nasal (lower in the figure) half has undergone slight changes and has retained its normal thickness. The choroid also differs in its two halves. In the nasal half the choriocapillaris is wanting in places and some larger vessels are hyperæmic, but the choroid here retains nearly its normal thickness. In the temporal half, however, there is marked hyperæmia of the larger vessels, and at many points extensive extravasations of blood, so that on the whole it is considerably thickened.

At some points in the temporal half the choroidal vessels are completely wanting, and the normal structure is replaced by a mass of spindle cells with oval nuclei.

The microscopic picture presented by the choroid and retina in the temporal half of the ball has much similarity with the pictures which Wagenmann, Capauner, Leber, von Hippel, and Krückmann have found after division of the ciliary vessels or after the introduction of metallic splinters into the interior of the ball. The question arises: How are we to explain the peculiar changes in the temporal half of the retina?

Since before the operation pigment changes were not ophthalmoscopically visible and three weeks later appeared in the microscopic picture, it seemed warrantable to attribute these changes to the operative procedure. In resecting the optic nerve the central vessels of the retina and all the posterior ciliary vessels were cut, including the long ciliary arteries. Interruption of the circulation in the central artery of the retina leads only to sclerosis of the retinal vessels and degeneration of the nerve-fibre and ganglion-cell layers. After section or simple atrophy of the optic nerve the same results are observed: the pigment epithelium remains normal and pigmentation of the retina never occurs (Wagenmann,[30] Hertel[9]). When both the optic nerve and the central vessels are cut, the same changes occur in the retina,

but the degeneration is more rapid. No immigration of pigment is found here. The same results were obtained by Schechmann[18] in dogs.

Berlin[3] and numerous others, among them recently Colucci,[5] have described cases of division of the optic nerve followed by the immigration of pigment into the retina, but Wagenmann and Hertel have proved conclusively that in these cases there was not simple division of the optic nerve alone, but of a number of the posterior ciliary vessels as well. The cause of the atrophy of the retina and the migration of pigment into it in our case must thus have been due to division of the posterior ciliary vessels.

As was said before, Wagenmann[20] was the first to study systematically and methodically the results of cutting the ciliary vessels alone, and in his paper will be found a critical *résumé* of the literature. After cutting the ciliary vessels alone he noticed a grayish cloudiness of the retina near the divided vessels, which passed off in five days, when a fine punctate pigmentation of the retina could be seen that gradually became more marked. The pigmentary changes were found exclusively in the sharply circumscribed portions of the retina that had been cloudy, corresponding to the divided ciliary arteries. The retinal vessels were of nearly normal calibre. The altered portions remained anæmic, as subsequent injections showed, the circulation being re-established only after the third day, and some regions still remaining bloodless.

Microscopic examination showed first a serous infiltration of the retina, most marked in the outer nuclear and rod-and-cone layers. The individual elements were smaller, and between the rods and cones and the pigment epithelium lay amorphous albuminous masses.

The pigment epithelial cells were in the beginning but little altered, some cells being detached and of irregular form. Many free pigment granules lay outside of the cells. In albino animals Wagenmann often found that at this stage the pigment cells were degenerating, since their nuclei no longer took the stain.

The inner layers of the retina also early showed altera-

tions, such as spreading apart of the elements of the inner nuclear layer, broadening and clouding of the inner reticular layer, and atrophy of the nervous elements.

The degeneration did not advance uniformly, for in the portions in which circulation in the choroid was restored the degeneration of the retina was checked.

Over the portions of the choroid most markedly affected one saw, two days after the operation, destruction of the rods and cones and loosening of the pigment epithelium.

Corresponding to the most extensively injured portions of the choroid, one saw, two days after the operation, destruction of the rods and cones, loosening of the pigment epithelium, granular degeneration of the outer nuclear layer, destruction of the inner nuclear layer, and shrinking or absence of the ganglion cells.

Six days after the operation, Wagenmann found the retina in the affected areas very much thinned and much pigment present in the retina, partly within cells and partly free.

When the optic nerve and central vessels, together with the ciliary vessels, were cut in one orbit, there was a rapid destruction of the retina, while with simple section of the optic nerve in the other orbit, a slow degeneration of the retina took place.

Capauner[4] also followed the development of retinal pigmentation in animal experiments. He divided the ophthalmic artery of the frog, and one long and some short ciliary arteries in the rabbit, and found that in a short time pigmented cells were present in the degenerated retina.

The fact that in our case there were only isolated foci of retinal degeneration in the nasal half of the retina and uniform degeneration of the entire temporal half of the retina, is perhaps to be explained by supposing that degeneration in the nasal half was prevented by the anastomosing anterior ciliary arteries in the nasal side, while the anterior arteries on the temporal side were interfered with by the tenotomy of the external rectus.

Anatomical examination of human eyes in which some weeks before enucleation optico-ciliary resection had been

done, has rarely been made, and no case exactly like our own has been found in the literature at our disposal. But the ophthalmoscopic changes have been studied in a number of cases in which resection has been done for tumors behind the eyeball. Schlodtmann[17] in his monograph reports three cases from von Hippel's clinic, gives a *résumé* of the literature, and discusses the fundus changes.

His cases are as follows:

Case 1.—Optic-nerve tumor removed after tenotomy of the internal rectus. Ophthalmoscopic changes seven months later. "Media clear; disk white and sharply outlined; all vessels narrowed, arteries more than veins, and their walls thickened; pulsation of the arteries when pressure is made upon the ball. In the macular region a previously existing exudation has given place to a group of pigment spots. Upward and inward from the disk there is irregular pigmentation of the fundus."

Case 2.—Optic-nerve tumor. Tenotomy of internal rectus; ophthalmoscopic changes six weeks later. "Disk grayish-white and cloudy. On the lower half of the disk (inverted image) there is a thin deposition of connective tissue which sends several radial processes a short distance out into the retina. This new tissue conceals the origin of the vessels running downward. The veins are large and tortuous and the main trunks have thickened walls. The arteries are very small and their walls are thickened. Pressure upon the ball does not affect the fulness of the vessels. Below the disk is a triangular hemorrhage, its apex nearer the lower margin of the disk. A disk diameter outward from the disk the fundus appears mottled, the pigment epithelium degenerated, and the stroma cells in part proliferated. Farther in the periphery there are many linear pigment spots in the retina, particularly outward and downward. In the pigmented areas there is marked atrophy of the choroid with thickening of the walls of the vessels. In place of the earlier opacity between the disk and macula, one sees some yellowish-gray spots in the retina. The medial half of the retina is free from pigment."

Case 3.—Optic-nerve tumor. Tenotomy of internal rectus; ophthalmoscopic changes twenty-four days after operation. "To the temporal side of the disk (inverted image?) slight discoloration of the fundus: yellowish spots alternate with pigmented spots. The pigment appears in patches and in lines and is black as

carbon. Along the course of the inferior vessels there is diffuse rarefaction of the fundus, with deposits of pigment in the retina. In the other portions of the fundus no pigmentation is visible."

Ophthalmoscopic appearances two weeks later:

Extending from the disk to the temporal periphery of the retina is a zone in which the retina contains patches of black pigment irregularly arranged. Among the pigment patches here and there the color of the fundus is lighter than normal. At one point within a patch of pigment a yellowish choroidal vessel is visible. In the remainder of the fundus there is no pathological pigmentation."

Many other cases reported had similar fundus changes. Scalinci, a month after operation, found:

"The retinal circulation restored. The pigment spots are more numerous, but limited to the nasal half of the fundus."

In this case, and in the following case reported by Gruening, there was no note as to the side of the orbit entered.

Five weeks after the operation: "The veins cannot be distinguished from the arteries. Many retinal vessels become small a short distance from the disk and grow broader in the periphery. The choroid is markedly atrophic on its temporal side and the overlying retina is pigmented in great plaques."

Thus in a great number of cases of optico-ciliary resection in which the fundus was examined some time after the operation, we find the same condition that was found anatomically in our case, namely, a marked degeneration and pigmentation of the half of the retina corresponding to the wound in the conjunctiva and Tenon's capsule made in tenotomizing the rectus muscle.

Schlodtmann explains the condition as we do. He says: "Perhaps the pigmentation of the retina and the atrophy of the choroid are the results of extreme nutritive disturbances in the eyeball, and it is *a priori* probable that if the anterior ciliary arteries were cut, visible changes would occur in the portions of the retina and choroid dependent upon the blood supply of these vessels."

The cases in which no degeneration and pigmentation appeared, such as Adamück's case and Schlodtmann's first case, were, for the most part, cases in which immediately after the operation there was no narrowing of the retinal vessels or any other change in the fundus. Schlodtmann's explanation here is that at the time of operation the retinal vessels compressed by the tumor had ceased to supply the retina, which was then nourished by the choroidal vessels, and, if the posterior ciliary vessels had been compressed, by the anterior ciliary vessels, the slow growth of the tumor permitting the development of such collateral circulation.

From what has been said it is clear that the atrophy and pigmentation on the temporal side in our case were doubtless due to division of the posterior ciliary vessels plus division of some of the anterior ciliary vessels. Only in the rabbit are the posterior ciliary arteries end arteries. Only in this animal is division of one long ciliary artery sufficient to cause these changes in one-half of the fundus. In man the collateral supply is better, and division of the posterior vessels alone is not sufficient to produce the fundus changes.

As regards the circulation in the choroid, we found that the nasal half of the choroid in our case contained an average amount of blood, but that in the temporal half there was a pronounced hyperæmia with extravasations of blood. These conditions mean that on the nasal side well-developed collaterals provided a sufficient blood supply, while on the temporal side the conjunctival incision and tenotomy had so reduced the collaterals that the choroidal vessels were overfilled with blood which was not in active circulation, leading to stasis and diapedesis of the blood cells through the ill-nourished vessel walls.

The fact that at localized points in the nasal half of the retina the pigment epithelial cells were enlarged and detached and pigment masses lay free in the retina, is explained by supposing that the collaterals of the nasal half of the choroid were not able to nourish the entire nasal half of the choroid after division of the posterior ciliary vessels. At various small points there were stasis and anæmia, giving rise to degeneration and pigmentation of the retina.

It remains to inquire into the nature and source of the large masses of pigment found in the temporal half of the retina.

When our preparations are carefully studied, it is seen that at particular points these large clumps of pigment still are arranged along the lamina vitrea (Fig. 4). At other points they are detached but lie in regular order in the cleft between choroid and retina (Fig. 5). So it is impossible not to believe that we have to do with enlarged and markedly pigmented pigment epithelial cells.

An enlargement of the pigment epithelial cells in nutritive and circulatory disturbances of the choroid is observed after experimental injury of the choroid in animals and also after pathological processes in the choroid in man. For example, after division of the ciliary vessels Wagenmann[20] and Krückmann [2] found it in the rabbit, and Capauner[4] in the frog. As regards similar changes in man, I would call attention to the changes found in the pigment epithelium by Wagenmann,[21] Bürstenbinder,[3] Deutschmann,[6] Gonin,[8] and others in retinitis pigmentosa ; to the marked enlargement and proliferation of the pigment epithelial cells in a patient with arteriosclerosis in the choroid described by Siegrist ; and to the familiar changes in the retinal pigment epithelium in cases of focal choroiditis and in the old as described in detail by Kuhnt[13] and Rosa Kerschbaumer.[11]

Usually the cells are enlarged and the pigment contents diminished. In our case, on the contrary, the pigment is much increased until it seems to be almost homogeneous, and only at the margins of the clump are individual pigment granules to be made out (Figs. 4–8). Clumps of pigment as large as these were found by Capauner and Krückmann in their experimental studies and by Leber and von Hippel[10] in their studies on bits of metal in the eye.

Krückmann[12] says : " If the atrophy of the retina extends to the inner layers, a process which happens quickly after the introduction of metals into the vitreous, further changes take place in the pigment epithelium and large clumps of pigment appear."

Whence come these clumps of pigment ? Either they are,

as Krückmann suggests, degenerating and degenerated grouped cells or cell derivatives, or they are phagocytic cells which have taken up the fuchsin granules of degenerated pigment cells, or they are pigment cells in process of division—that is, cells in which there are newly formed fuchsin granules.

Autochthonous development of organic pigment in fully developed cells is unknown. The genesis of these clumps through cell division must be considered highly improbable. After bleaching, all these pigment clumps exhibit well staining nuclei, showing that they are not composed of degenerated cells. It would seem likely that these clumps of pigment, which in some sections rested on the lamina vitrea at the site of the pigment epithelium, in other sections lay in the space between the choroid and retina, and in others still lay scattered through the retina, were composed of viable cells which had taken up other pigmented cells, or at least the pigment of other cells.

What, then, are these phagocytic cells? Are they leucocytes, as Wagenmann assumed in his cases, or are they pigment epithelial cells, which from lack of nutrition have acquired phagocytic properties, and have absorbed broken down pigment epithelial cells, and thus become large and densely pigmented, and actively or passively have found their way into the atrophied retina? There is no question here of phagocytic leucocytes, since round cells are nowhere to be found in the retina.

The suggestion that the pigment epithelial cells have the power of taking up pigment from broken down cells, and thus of playing the part of phagocytes, was made by Leber in his studies on the effect of bits of metal in the vitreous. And von Hippel,[10] in human eyes that had contained splinters of steel and in rabbits' eyes into which iron had been introduced, found similar large, densely pigmented cells, which he took to be pigment epithelial cells, which from some excitation had enlarged, proliferated, and become loosened, and had furthermore acquired the power to absorb foreign substances and to wander actively.

Capauner[4] and Gayet and Aurand[7] saw similar cells. Capauner believed them to be pigment epithelial cells and

Gayet and Aurand inclined rather to the view that they were leucocytes which had taken up the pigment of broken down epithelial cells.

I am of the opinion that these cells are enlarged phagocytic pigment epithelial cells which have absorbed degenerated cells of their own kind. The number of these cells in the sections is less than would be that of normal pigment epithelial cells, so that unquestionably many of the pigment epithelial cells have broken down. The presence of well staining nuclei in the cells free in the retina would seem to indicate that they had migrated actively from their original position.

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POSTERIOR SCLEROTOMY AS A PRELIMINARY TO IRIDECTOMY IN ACUTE GLAUCOMA.

By ARNOLD KNAPP, M.D.

PRIESTLY SMITH in the chapter on Glaucoma, p. 680, in *Norris and Oliver's System*, describes scleral puncture as a preliminary to iridectomy in glaucoma to permit a more thorough operation. He has performed this combined operation in more than 50 cases without any ill effect referable to the additional step and with the impression that the results have been improved thereby. I have been practising this combined method under more restricted conditions and apparently with advantage. The cases which to me seem to require this preliminary operation are cases of primary acute glaucoma or chronic glaucoma during an inflammatory attack where the eye is very hard and the anterior chamber so shallow as not to permit a satisfactory incision.

The following seven cases were treated by this method. The operation was performed under general anæsthesia. The method followed was the one described by Mr. Smith. On turning the eye well inward, exposing the outer surface of the sclera, the sclera is punctured with a cataract knife a little above or below the horizontal meridian; by rotating the knife vitreous escapes. The sliding conjunctiva protects the incision. The eye becomes soft, the anterior chamber deepens. The ordinary iridectomy then follows.

CASE 1. A. McK., sixty-two years old. After three weeks of acute glaucoma, V = $\frac{10}{200}$, combined posterior sclerotomy and iridectomy were performed on September 15, 1905. No reaction.

Two weeks later, vitreous clear, tension normal. V = $\frac{20}{100}$. The field concentrically contracted. On October 17th (the last visit) the tension was normal. V = $\frac{20}{70}$. Arteriosclerotic changes in both maculæ.

CASE 2. F. K., fifty-six years of age. The right eye was enucleated for painful absolute glaucoma two years ago. On September 29, 1904, he came to the hospital with a very marked attack of acute glaucoma in his remaining eye. The anterior chamber was practically obliterated, cornea steamy. T+ 2. This attack had occurred suddenly on that morning. He got up experiencing great pain and loss of vision. Under ether a posterior sclerotomy and iridectomy were performed without incident, except that after the sclerotomy the anterior chamber did not deepen as much as usual, and the lens remained permanently displaced forward, making the eye myopic. Subsequently the tension remained minus for some weeks, as it frequently does after this operation, and then became normal. Some minute hemorrhages were seen in the fundus. On date of last visit, Jan. 17, 1905, V – 2D = $\frac{20}{70}$. The lens is still extremely far forward. The vitreous is clear. Optic nerve n. Tension n. Some months later he died from apoplexy.

CASE 3. A. J. J., fifty-nine years of age, left absolute glaucoma. Right loss of vision for three months, premonitory attacks during one year. At present there is acute glaucoma with only perception of light. Under ether a combined operation was successfully performed. The tension was relieved. No reaction. Vision improved to $\frac{6}{100}$. Subsequently the cataract was removed and the optic nerve was found atrophic. The field was very much contracted. Later the tension increased and eserin had to be regularly instilled. The patient returned to his home in Panama and subsequently became blind.

CASE 4. A. S., aged fifty-one, was first seen in April, 1904, suffering from an acute exacerbation of chronic glaucoma. The eye has been inflamed for five weeks. The vision was reduced to recognizing the movements of the hand in the temporal field. The combined operation was performed under ether. On leaving the hospital the tension was normal. The vision somewhat improved. On May 21, 1906, R = $\frac{6}{100}$. F: nasal defect to near p. f. Od.: cupped, atrophic. T n.

CASE 5. D. A., aged sixty-six. Acute inflammatory glaucoma, left, of two weeks' duration. Vision reduced to perception of

light. Under ether the combined operation was satisfactorily performed on December 18, 1904. The pain was relieved, tension normal. On January 3, 1905, Vision, could count fingers. T n. On May 21, 1906, V = $\frac{20}{100}$. T n. Nasal contraction of field to 40°.

CASE 6. A., seventy years of age. Acute exacerbation of chronic glaucoma, with faint perception of light, and cataract. Combined operation on August 31, 1904, without incident. September 13, 1904, the date of last visit, T n. L. p. uncertain, especially nasal.

CASE 7. A. K., twenty-eight years of age. This patient applied for the relief of pain on account of glaucoma secondary to dislocation of the lens into the anterior chamber, which had resulted from an old traumatism. There was complete atrophy of the iris. It was decided to precede the extraction of the lens by a posterior sclerotomy. When the knife had penetrated the sclera and some vitreous had escaped, blood appeared after a few seconds in the bottom of the anterior chamber. There was no bleeding from the site of puncture. The lens was easily removed through the customary corneal incision, but as the corneal wound gaped slightly an intraocular hemorrhage was surmised and the patient's eye was quickly bandaged. In ½ hour the bandage was saturated with blood. The usual history of intraocular hemorrhage followed and the eye was enucleated one week later.

Though the number of cases reported is small they nevertheless, to my mind, confirm the advantages of this method of operating under certain conditions. There is no doubt that the preliminary reduction of tension is a great aid to obtaining a proper corneal section and a satisfactory coloboma. The hypotomy of the eye after operation enables the instillation of atropine to be kept up for several days. Whether the operation in the favorable cases exerted any particularly beneficial action on the glaucomatous process, beyond permitting a thorough iridectomy to be done, is a question which cannot be answered, nor does it enter into the province of this paper. The only case in which this combined operation apparently aggravated the condition was the one (Case 7) in which an intraocular hemorrhage occurred. This fatality would, I think, have also followed the usual

operation, as the eye was a degenerated one. The hemorrhage did not appear at the site of the scleral puncture, and so presumably took place from the relaxation of the intraocular tension and not from the scleral incision.

TWO CASES OF OSTEOMA OF THE ORBIT SUCCESSFULLY TREATED BY OPERATION.

By ARNOLD KNAPP, M.D.

(*With a photograph on Text-plate IX.*)

THE two following cases of osteoma of the orbit illustrate the difference in the site of origin in these tumors; they were successfully removed by operation without involvement of the eyeball.

Case 1.—J. C., female, twenty-eight years. A swelling had been noted below the eyebrow in the orbit for some years. This had increased in size.

On examination there is a nodular, hard tumor to be felt within the orbit in the upper and inner angle. The eye is normal except that it is displaced down and out. Nose not involved. The nodular, hard growth, the position, and the slow increase in size made the diagnosis of osteoma certain.

Operation August 31, 1905. Usual curved incision along the convexity of the eyebrow, down to the nose; on separating the periosteum the tumor was disclosed with a narrow neck to which the periosteum was attached. The attachment was to the upper part of the posterior half of the ethmoidal os planum. With a chisel the bone was divided just anterior to the attachment; the growth was then readily detached as the pedicle was small, measuring about *1cm* in diameter. The tumor was freed from the surrounding soft parts and removed from the orbit. The site of attachment appeared healthy, and the ethmoidal cells were not further opened. The wound was closed with sutures and healed by primary union. Subsequent course uneventful.

October 16th.—The eye has returned to its normal position.

There is no deformity. Vision normal. Some diplopia in lower part of field.

The tumor measures 2 x 3*cm*. The accompanying photograph shows its shape and attachment. (See illustration.) As the periosteum was tightly adherent to the neck of the tumor, it is probable that the growth took place superficial to the bone.

The second case is more interesting, as the bony nature of the growth was not determined until the operation.

CASE 2.—M. A., female, twenty-nine years old. Eight years ago patient states that the left eye would "swell up"; occasional headache; the eye has been steadily becoming more prominent.

On examination left eye is displaced forward and downward on the cheek. On palpating the region of the upper lid a hard nodular tumor is encountered just within the orbital margin; the lachrymal gland is displaced. Most of the mass seems to spring from the upper and inner wall.

Left eye: OD, some congestion. $V = \frac{20}{100}$.

Operation December 6, 1905. Usual incision. Very free hemorrhage; difficult to detach periosteum. On doing so, glarish viscid mucus escaped from above and inward (frontal sinus). A nodular mass was found occupying the upper half of the orbit, with a firm, broad attachment to the entire upper bony wall. Owing to the broad attachment it was necessary to remove the tumor in fragments. This was difficult as the bone was very dense. The tumor sprang from the superior (cerebral) wall of the frontal sinus; the attachment extended one and three-quarter inches back from the orbital margin. A narrow rim of bone remained anteriorly of the inferior (orbital) wall of the frontal sinus which had been perforated by the growth. In removing some of the tumor internally the dura was exposed. In the posterior half of the orbit the periosteum appeared as a thickened whitish membrane. Posterior to the tumor an œdematous polypus was encountered. Wound left open. Gauze drain to dura. The tumor removed measured approximately 4 x 2*cm* and weighed 5.15*g*.

Uneventful recovery. Wound closed in eleven days.

No deformity except the eye has remained lower down than normal. Diplopia in lowest field. Vision unchanged.

ILLUSTRATING DR. ARNOLD KNAPP'S CASE OF OSTEOMA OF THE ORBIT.

Exostoses of the orbit are not uncommon. La Grange[1] has collected 148 cases. They are only partly derived from the periosteum as an osteoma of the frontal and sphenoidal sinuses may arise from the embryonal cartilaginous rudiments of the ethmoid (Lesser[2]). They then enlarge and break through the bony walls and extend into the orbit or into the skull. Panas[3] states that the sinusal exostoses are covered with a fibro-mucosa which becomes red and cystic. The site of predilection is the upper and inner walls of the orbit. The extension inward into the cranial cavity is of course very serious. This is, however, very rare. Symptoms suggestive of this extension are absent in most cases. La Grange says that there are only very few on record which have caused grave cerebral symptoms. A fatal termination in these cases, if left to themselves, is also very rare; of ten cases two were fatal. This extension into the cranium need only be suspected, if the osteoma arises from the upper wall of the orbit.

As to treatment, the difficulties and dangers of operation vary with the location and breadth of attachment of the tumor. These tumors can generally be safely removed with preservation of the eyeball. Some cases have succumbed to meningitis after operation; though these mostly occurred in the pre-antiseptic era, some are of recent years. The mortality of the operation, according to La Grange, has fallen to six per cent. since the days of antisepsis. The removal of a pedunculated tumor as in our first case is very simple. In the second case, where the attachment occupied nearly the entire roof of the orbit and an intracranial extension could not be excluded, it is better to only resect the orbital mass as has been advised by Panas.

[1] *Traité des Tumeurs de l'Œil*, etc., vol. ii., p. 346, 1904.
[2] *Allgemeine Chirurgie*, ii., p. 288, 1905.
[3] *Maladies des Yeux*, vol. ii., p. 417, 1894.

EYE INFECTION. THIRD HUNDRED CASES WITH BACTERIOLOGICAL EXAMINATION.

By Dr. DORLAND SMITH, Bridgeport, Conn.

THE statement of careful observers as to the many kinds of bacteria present in the healthy conjunctival sac, the inability to prove or disprove by animal inoculation the causal relationship of germs to the infection of the eye from which they were isolated, the lack of time and the difficulties of technique which practically prevent the busy man from doing laboratory work, and our failure, without actually doing this work, to appreciate fully the meaning of cultures and the care required to make them informing and not misleading—all these create some confusion in our ideas of the bacteriology of eye infection. But we are making progress, and this state of mind will not continue.

It is well known that the variety of micro-organisms which may *occasionally* be present in the healthy conjunctival sac is very large. *Practically*, however, but few kinds of organisms are commonly found, the so-called "normal" inhabitants of the conjunctival sac. The pyogenic cocci and bacilli of the xerosis, colon, and subtilis groups, some of which have pathogenic possibilities, are the commonest of these. These organisms are not numerous, under normal conditions do not propagate, and do not ordinarily cause infection without another factor generally called, for want of a better term, "lowered resistance." Ordinarily the eye has special protection against germ invasion. The resistance of healthy epithelium to germ entrance, the phagocytosis, the constant flushing of the tears, the mechanical scraping of the lid

edges, contribute to this protection, tend to rid the eye of these "normal" inhabitants, and do succeed in keeping their number low. When this resistance is lowered, either through impairment of the general health or by some injury to the conjunctiva or cornea, and a way of entrance for the germs is provided and infection results, the infecting germ becomes more numerous—much more so than the other germs which happen to be present, which are still kept more or less in check by the same agencies as before. Thus the presence in small numbers of adventitious organisms, or of the common germs of the healthy conjunctival sac in an infective condition, does not preclude the discovery of the infecting germ. It does require greater care in the examination and greater exercise of judgment to prevent mistakes. There is the least likelihood of error if the conjunctiva is thought of as an exposed Petri plate, and the material under examination as probably already contaminated by a few adventitious organisms; too few to appear prominent in the smear, but which may overgrow and entirely vitiate the culture unless it is carefully watched.

In the search for the infecting germ, both smear and culture of the infected material should be made. While examination of smears alone is often useful, when it is possible to study cultures with care the great increase in accuracy well repays the increase in time and trouble. In the smear the kinds of organisms and the relative number of each should be noted, their morphological and staining peculiarities and their relation to the pus cells and to each other observed. This is necessary both as a basis for judgment as to which are infecting and which accidental organisms, and because some of the organisms which infect the eye do not grow on ordinary media, or do so only with difficulty, and without a smear they would not be discovered at all. Cultures should be made on appropriate media to verify or disprove conclusions from the smear as to the kind of organisms causing the infection, and to isolate the infecting organisms for accurate identification.

Except in the case of a few organisms of characteristic morphology, identification from the smear alone is often

quite uncertain. At the same time the possibilities of error introduced in making cultures should be kept in mind; not only accidental contamination, through faulty technique, but especially the growth of the adventitious or normal organisms. For this reason cultures uncontrolled by examination of the smear may be quite misleading. To minimize the chances of error from this source the infective material should be spread over the whole surface of the culture media, the growth inspected at frequent intervals, and those organisms isolated and studied which were prominent or abundant in the smear and in closest relation to the pus cells, and are therefore the probable infecting agents. The few widely-scattered colonies of the common inhabitants of the conjunctival sac may be neglected, as presumably they have little connection with the infective process, but were accidentally introduced into the eye from the air.

It is unfortunate that it is not usually possible to obtain by animal inoculation complete proof of the etiological relationship of the organism we have isolated to the disease of which it is the probable cause. But the fact remains that many germs which infect the human conjunctiva will not infect that of animals. We have therefore to assume that certain organisms are the cause of certain eye diseases without this absolutely complete proof. We do this because all the facts we can obtain point to the truth of this assumption. We find, for example, in an epidemic of conjunctivitis the same organism predominating in the conjunctival discharge of all the cases, or the only constant organism in all or in a majority of them (excepting, of course, the few normal inhabitants of the conjunctival sac). Thus we find Koch-Weeks bacillus in some epidemics, pneumococcus in some, and in some, other germs.

In another class of cases we may have a history of direct inoculation, as of gonococci from urethra to eye, or of Klebs-Loeffler bacilli from nose to eye, and find the same sort of infection and the same kind of germ in both places. In still another class the results from treatment indicate the nature of the germ infection. Thus the cases of subacute conjunctivitis in which the diplobacillus is the only constant

organism yield readily only to zinc; diphtheritic conjunctivitis likewise to anti-toxin. There are so many of these cases in which all the facts at our disposal point to the same conclusion that it is difficult not to believe that the abundant germ is usually the specific cause of the infection.

We report one hundred more cases of bacteriological examination of secretion from the eye. These examinations were made whenever secretion was present. The cases occurred in the private practice of Dr. F. M. Wilson and myself in the ophthalmic clinic of the Manhattan Eye and Ear Hospital, and in the wards of the Bridgeport Hospital. They include all the eye cases in which any attempt at bacteriological examination was made. Some of the laboratory work was done in the Sheffield Bacteriological Laboratory of Yale University, and my acknowledgments are due to its head, Prof. L. F. Rettger, for valuable assistance; also to Dr. E. M. Blake, who made a few of the laboratory examinations; and especially to my colleagues at the Manhattan for the cases which they have put at my disposal.

Technique.—This was essentially the same as in the preceding two hundred cases,[1] except that the conjunctival discharge was more often collected by the sterilized platinum loop and transferred directly to the culture tubes and slides. Both smears and cultures were regularly made, and such organisms as grew and were also present in any considerable number in the smear were isolated in pure culture and identified by the usual methods.

One hundred and one patients are included, 145 eyes being affected. The cases are grouped as infections of the conjunctiva (70 cases), of the cornea (9), of the lachrymal sac (7), and other cases (15).

CONJUNCTIVAL INFECTION: 70 CASES, 110 EYES.

Koch-Weeks Conjunctivitis. Twelve cases. In all these the slender, faintly staining bacilli were found in considerable num-

[1] *Yale Medical Journal*, May, 1904, and *Manhattan Eye, Ear, and Throat Hospital Reports*, vi., 172; ARCHIVES OF OPHTHALMOLOGY, xxxiv., 5, and *Manhattan Eye, Ear, and Throat Hospital Reports*, vii., 137.

bers in the smear, usually both in and between the pus cells. In two cases only were cultures made, one on serum agar showing Koch-Weeks bacillus in pure culture, the other on blood serum showing xerosis only. Only one case occurred in Bridgeport. This was in a woman of twenty-three, five days' duration, and severe enough so that some one had used atropine. Recovery in four days under boric acid solution and hot water. Eleven cases occurred in the clinic at the Manhattan: 2 in children, 8 in young adults, and 1 in a man of fifty-three. All but two were males. In all the ocular conjunctiva was quite red (pinkeye), and in most the secretion was free. In eleven cases both eyes were affected, usually one a day or two before the other, the patient coming in soon after the second eye became affected. The treatment was regularly boric solution every two hours, and argyrol two to four times a day. Recovery in four to seven days in the cases which remained under observation.

Pneumococcus Conjunctivitis. Four cases. These were all rather mild. One was a clinic case in a boy of four, right eye only affected; three were in men. The pneumococcus was found alone in smear from three of the cases and in culture in all of them. In two a few colonies of the adventitious organisms (staphylococcus and xerosin) also appeared. Treatment was boric solution; one had hot water and one argyrol also. One was well in five days, one in six; the other two were not seen again.

Streptococcus Conjunctivitis. One case. This was in the right eye of a woman of fifty, who had had an abscess of the right lachrymal sac three years before. Streptococci and a few xerosis bacilli were found in the conjunctival discharge. Under boric and hot water the redness and secretion disappeared in a few days and the patient was dismissed. Three weeks from the date of the first visit she returned with another abscess of the right lachrymal sac. This was opened externally and streptococci were found in the abscess and again in the conjunctival discharge. A localized erysipelas then developed about the wound. After this cleared up and the prominent symptoms were relieved by probing, the patient disappeared.

Gonorrhœal Conjunctivitis. Five cases. Two of these were in boys of two and four, brothers, whose parents declined hospital treatment, and the patients were seen but once. The other three were adults. One was a savage infection in a woman of thirty-nine, who had been poulticing her eye with tea leaves. The pus was examined and gonococci found. She was treated in the Manhattan Hospital, but her physician reported that the resistance had been so lowered by poulticing that corneal invasion could not be prevented, and the final result was P L only.

A girl of fifteen entered the Bridgeport Hospital with an active infection of the right eye of twenty-four hours' duration, with great swelling of the lid. Twenty-four hours later a slight haziness appeared in the centre of the cornea, but disappeared under atropine and cleansing with boric and vaseline every half hour by special nurses, without any break in the epithelium, and without any resulting opacity. The left eye became infected in spite of precautions, but cleared up rapidly under the same treatment. Discharged well in ten days.

The fifth case was a woman of fifty-five, who entered the hospital with a severe infection of the right eye, thirty-six hours old. There was so much swelling of the lids as to almost prevent opening them, and a hard, pale chemosis surrounding the cornea. Under cleansing with boric solution and vaseline every twenty minutes by special nurses the secretion lessened and the chemosis did not increase. Within thirty-six hours the other eye became infected and argyrol, 30 per cent., was used, one drop q 1 h in the second eye, q 2 h in the first eye. This caused smarting in the first eye only. The second eye was well in two days. The first eye, without any apparent infection of the cornea, lost most of the corneal epithelium, the cornea staining deeply with the argyrol. Discharged in twenty-six days with faint opacity. One cannot feel quite sure that the argyrol had no part in the loss of epithelium.

In all these cases the characteristic biscuit-shaped diplococci, decolorizing by Gram, were found in abundance in smear, both in and out of the pus cells. Cultures were made

in one case. In this the gonococci grew very slightly on the blood serum, as they exceptionally do, and xerosis bacilli were also present.

Staphylococcus Conjunctivitis.—Twelve cases. In seven of these the predominant organism was very abundant in the smear, and was found to be one of the pyogenic staphylococci by cultures on blood serum, agar, and gelatine. The secretion was very free, and the cocci were often in the pus cells. All but one case were mild. In three cases the staphylococcus occurred alone, in three xerosis also, and in one with another bacillus. One boy of six had staphylococcus albus and a few xerosis. Two clinic children, with considerable pus, but little redness or swelling, showed S. aureus and albus. In one case the organism was the cereus. The outcome of these is unknown. The conjunctival discharge from the irritation of an artificial eye in a woman of sixty showed S. aureus and albus. A girl of thirteen with traumatic cataract after seven weeks of occlusion developed a free secretion containing S. aureus and xerosis. This subsided without treatment other than cleansing at the daily dressing, the occlusion being continued. In an acute conjunctivitis with faint corneal disturbance, puffiness of the lower lid, and watery œdema, in a man of sixty-four, the discharge showed S. aureus and xerosis in small numbers in smear and culture. Recovery in two weeks under boric, hot water, and argyrol. It is by no means certain that the staphylococcus had anything to do with this process, especially as a similar attack, except for the corneal disturbance and with pneumococci predominating, occured two months later.

In five cases of mild purulent conjunctivitis in which no cultures were made smears showed abundant cocci, positive to Gram, and often intracellular, which were probably staphylococci. Three cases were in children of seven days, two and three years respectively, both eyes affected. Two of these were not seen again; in the third the conjunctivitis yielded rapidly to treatment, but an ulcerative keratitis developed which was very persistent. The other two were in babies of seven and ten days, one eye only affected,

recovering in three and two days respectively under simple cleansing with boric solution.

Diplobacillus Conjunctivitis. Ten cases. These were cases of subacute conjunctivitis in the discharge from which the diplobacillus of Morax and Axenfeld, or an organism very like it,[1] was the prominent or sole organism. The symptoms were regularly mild but persistent. Both eyes were affected for some weeks before coming under observation, in two cases more than six months. The slight redness of the bulbar conjunctiva in the palpebral opening, or the velvety thickening of the tarsal conjunctiva of the lower lid, together with the history of long duration, often enabled the diagnosis to be guessed at without waiting for the bacteriological report. Six patients were males, four females; seven were young adults. In five cases the organism was found alone in the smear and no culture was made. Both smear and culture were made in five cases, showing, in addition to the diplobacillus, xerosis in one, an unidentified bacillus in one, and in one a member of the hay bacillus group. The treatment regularly used was the chloride of zinc, $\frac{1}{2}$ to 2 grains to the ounce of boric solution, dropped in the eye three or four times a day. There is no record of the result of treatment in four clinic cases, as the patients did not return. One clinic case recovered in four days. Of the five office cases three received prompt relief from the zinc drops; two of these had used boric solution for three weeks with little improvement; one was a relapse from similar attacks twelve and three months before; one had a relapse four months later, each time being relieved by the zinc solution in two days. The last case required twelve days for recovery, and had a relapse four months later. The identification of the diplobacillus in this case was doubtful, and the hay bacillus was also present.

[1] In these cases of subacute or chronic conjunctivitis with the symptoms described above, which we call diplobacillus conjunctivitis, the cases for which zinc is a specific, we find several organisms, differing among themselves, yet more closely related to each other than to any other organisms, and all giving much the same clinical picture. Of these the diplobacillus of Morax and Axenfeld itself, another larger diplobacillus, and the so-called bacillus of Petit are fairly common.

The Xerosis Bacillus was the only organism found in seven cases of mild conjunctivitis. In three it was present in both smear and culture. One case was an ophthalmia neonatorum; one a purulent conjunctivitis in a baby; one a phlyctenular affection; one a conjunctival affection grafted on an old trachoma. One case showed some redness and little secretion, one free secretion and no redness, one both. All made rapid recovery with simple cleansing. In another case the xerosis was the prominent organism in smear and culture, and there were hay bacilli also in the latter. This patient had the same sort of attack several times, each time with xerosis the prominent or sole organism, and each time getting the most relief from argyrol. She had a Bowman's operation some years ago and has a wide canaliculus and an especially large lachrymal duct, through which it seems likely that the infection comes up from the nose.

In two cases, bacilli only were found but not identified. In a man of 26 with conjunctivitis there was an intracellular diplobacillus in smear; no culture. In a man of 40 with trachoma there were no organisms in the smear but a variety in culture, each in very small number.

No Organisms. In sixteen cases of conjunctivitis no probable bacterial cause for the inflammation could be made out. With one exception these cases were all mild and made quick recovery under cleansing with boric solution. In the smear from most of these cases there were many pus cells and often considerable fibrin; in a few only broken cells and débris. But there were no organisms, or only so few of the organisms normally present on the conjunctiva as to seem clearly adventitious. Blood serum and agar cultures, when made, either showed no growth or a few colonies only of the adventitious organisms. These cases comprised all ages: five were in babies (two ophth. neon.), four in children, and seven adults. Only six were clinic cases. In six there were no organisms in smear or culture; in five none in smear, cultures not made; in four the smear was unsatisfactory; in two of these there was no culture and in two the culture also was unsatisfactory. One of these was a severe case of five days' duration with puffiness of the lower lids,

which took ten days for recovery. In one case a phlyctenule was excised under cocain and planted on blood serum; but no growth resulted.

CORNEAL INFECTION. NINE CASES, ELEVEN EYES.

There were two cases of necrosis of the cornea. The first, in a man of twenty-nine, followed an infected ulcer, the result of an injury with a piece of horse's hoof. In the pus from the sloughing cornea a small bacillus was very abundant. This was found to be the bacillus pyocyaneus by cultures. No other organisms were present except a very few staphylococci and xerosis bacilli,s o few as to be clearly adventitious. Recovery with dense leucoma.

The other case was a peculiar one. A woman of sixty-seven entered the Bridgeport Hospital with a double pneumonia. Her condition became very serious, and for several days there was little hope of her recovery. The right cornea was found to be sloughing, with a large perforation through which the lens escaped. The secretion from the eye contained a very small streptococcus and the bacillus mucosus capsulatus (or a member of that group). Under vaseline and occlusion healing went on quietly, resulting in a dense leucoma with anterior synechiæ. Healing was interrupted by an abscess of the right lachrymal sac which developed a week later, in the pus from which staphylococcus aureus only was found. The left eye for a time remained well; but while under observation a perforating ulcer developed in spite of treatment. This was small, not quite central, and healed under atropine and argyrol without disturbance of the lens, leaving her finally with vision enough for reading. The germs found in the pus from the left eye were staphylococcus aureus, with a few xerosis bacilli and another bacillus. Was the poor resisting power of the cornea or the virulence of the germs which happened to be present the important factor? Was this a case which would have sloughed anyway from lack of corneal nutrition of the cornea and conjunctiva had been sterile, or was it an infection which was more severe because of the lowered resistance of the cornea?

Three were cases of ulcerative keratitis. In a woman of forty-six treated principally by occlusion, streptococci were prominent in smear and culture of the conjunctival discharge. Aside from an eczema of the cheek which made abandonment of occlusion necessary, recovery was normal. Two weeks later an abscess of the lachrymal sac developed on the same side, with streptococci and an unidentified bacillus in smear and culture. In the case of an ulcer following removal of lead deposit from the centre of the cornea in a woman of seventy-one, the bacterial record is unsatisfactory. In the very free conjunctival discharge in a case of corneal ulcer in a girl of three, staphylococcus albus and xerosis were found in large numbers.

In a case of keratitis of two weeks' duration in a man of twenty the lower third of the cornea was peppered with punctuate infection. The conjunctival discharge was too scanty for a smear, and although staphylococcus aureus and the hay bacillus were abundant in the culture, their relation to the corneal infection cannot be assumed. The man was well in two weeks with atropine, vaseline and occlusion.

An Italian, aged thirty-eight, came to the clinic with mycotic keratitis of two days' duration. He gave a history of similar attacks for the past two years. The cornea and the conjunctiva in the palpebral fissure were dotted with round punctuate spots, white or cream color, slightly raised and looking very much like a plate culture. There was not much irritation for so extensive a process. Under cocain scrapings were taken from the spots in the cornea, using a sterile " baby Graefe " knife and digging well into the tissue. These were transferred to blood serum tubes, but no smear was made. These tubes developed a growth of one of the moulds. The precaution of sterilizing the cocain was unfortunately not taken, and one cannot, therefore, be certain that the mould did not come from the cocain rather than from the mycrotic spot. The outcome of the case is unknown, as the patient did not return.

In two cases of keratomalacia the question of tuberculous origin arose, and under general anæsthesia sections were sliced from the cornea with a Graefe knife, triturated in

sterile water, and injected into a guinea pig. The first was a boy of four, a patient of Dr. Wiesner's. Here iris and cornea were matted together in a granulating mass, in scrapings from which giant cells were found. The pig receiving this inoculation remained perfectly well for three months, when he was used for other purposes. Thus there was no positive evidence, but what evidence there was favored the diagnosis of infective granulomata rather than that of a tubercular process. The child recovered with vision equal to light perception only. The second case was an eight-months-old baby, with both eyes affected, a patient of Dr. Webster's. A similar procedure was followed, the pig in this case dying in a week from streptococcus infection. We therefore have no evidence as to whether this case was tubercular or not.

LACHRYMAL INFECTION. SEVEN CASES.

Three were cases of dacryocystitis in women of seventy-five, forty-one, and fifty-five, with streptococci, pneumococci, and both pneumococci and staphylococci, respectively, in the secretion squeezed out from the sac. Cultures, made in the first two only, confirmed the smear, showing also a very few colonies of the adventitious organisms. Two cases were probed until the prominent symptoms were relieved and then disappeared; one declined probing. Four were cases of abscess of the lachrymal sac. In one, a woman of twenty-seven with a fistula of two months' duration following the abscess, the bacterial examination was unsatisfactory. In a man of forty-one, double abscess, pus from incision showed pneumococci only in smear; no culture. In a woman of forty-six, opened through canaliculus, pus showed streptococci only in smear, and the same organism with some xerosis bacilli in culture. This case has been probed at intervals for six months, and is slowly improving. The probing was interrupted at one time by the appearance of a very hard swelling, red and tender for a few days, with a crescentic edge presenting from within the lower edge of the orbit. This followed the accidental injection of cocain into the tissue along the canaliculus. Under hot water, it disap-

peared entirely in four weeks. The other case is more fully described among the corneal infections. In a sloughing cornea streptococci and B. mucosus capsulatus were found. The lachrymal sac on the same side became red, swollen, and tender two weeks later, and in the pus expressed staphylococcus aureus only was found. Recovery with epiphora under expression and hot water without probing.

Two cases, one of ulcerative keratitis, one of streptococcus conjunctivitis, before mentioned, had streptococci in the conjunctival discharge and later developed abscess of the lachrymal sac, with streptococci in the pus from the sac. With these additional cases there were nine in all, eight of which were in women.

OTHER CASES—FIFTEEN.

Tubercular ulcer of the conjunctiva in a girl of sixteen, a patient of Dr. J. J. Thomson's at the Manhattan Eye and Ear Hospital. The ulcer was gray, with slightly undermined edges, and lay over the centre of the tarsal cartilage of the right upper lid, extending rather deeply into it. The appearance of the ulcer suggested tuberculosis, and scrapings were examined in the pathological department of the hospital, but no evidence of tuberculosis was found. There was no loss of weight, no lung or other symptoms of tubercular infection, and no family history of tuberculosis; but, as an enlarged preauricular gland appeared on the same side and the appearance of the ulcer remained suspicious, at the request of Dr. Thomson a large piece of the edge of the ulcer was excised under cocain, and after trituration in sterile water injected into a healthy guinea pig. The pig died five weeks later with generalized tuberculosis. Meanwhile the enlarged gland was excised, and the process there found to be a tubercular adenitis. The conjunctival ulcer healed rapidly under simple cleansing, and up to date, six months later, the patient has remained well.

Papilloma on the tarsal conjunctiva of the left upper lid, five weeks' duration, in a woman of thirty-nine. There had been some pain and bleeding for five days, but neither was severe until within twenty-four hours. Scrapings from the

bleeding surface (after washing with boric) showed abundant staphylococcus albus in smear and culture, and a few unidentified bacilli. The subsequent history of the case is unknown.

Orbital abscess with great exophthalmos in a boy of six, from which a large amount of foul-smelling pus was evacuated through an incision in the lower and inner edge of the orbit. This pus contained a variety of organisms in smear and culture, the most abundant in the smear being streptococci and a slender bacillus morphologically like the tubercle bacillus but not acid-fast. The infection apparently started somewhere in the nose. A week later there was a fistula from the abscess through the anterior end of the inferior turbinate. Five weeks later, an abscess on the side of the nose, apparently starting from the same point as the original abscess, contained streptococci only. The exophthalmos subsided, and complete recovery followed the maintenance of good drainage.

A probable case of lupus in a woman of twenty-seven. When first noticed there was a small swelling on each side of the centre of the margin of the left upper lid, with a smooth cicatrix in the V-shaped notch between. These tumors were slightly red and not at all painful or tender on pressure. On one there was an area of ulceration covered by a scab. As bearing on duration, the woman had been in three months before for glasses, and the lids were then normal. The left pupil was permanently somewhat larger than the right, and contracted very little to light or accommodation. R. V. $\frac{20}{30}$; with + 0.50 + 0.25 c ax 180, $\frac{20}{15}$. L. V. $\frac{20}{40}$; with + 0.25 + 0.25 c ax 90 $\frac{20}{30}$ +. Near point about 7 in. in each eye. The patient was poorly nourished, had a persistent cough without much expectoration, and was at times quite hoarse. Sputum examination negative. The throat clinic reported slight congestion of vocal cords only, with no evidence of tuberculosis or syphilis. Vigorous rubbing of the lid margin with yellow oxide ointment was regularly carried out for some months and attention directed toward improving the general health. Under this treatment the ulceration healed and the swellings grew

smaller, at the same time extending each way along the lid margin, leaving a smooth white cicatrix, with some loss of tissue. In about three months the swellings disappeared entirely, the patient gained weight, and the hoarseness and cough disappeared. During this time the New York Board of Health examined her sputum without finding the bacilli, and later gave her the tuberculin test with negative results. Several examinations of the material from the edge of the lid were made, no organisms but the pyogenic cocci being found. After six months, in which she complained only of the trichiasis caused by the entropion, another ulcerated swelling appeared at the outer canthus of the same eye, and the cough, hoarseness, and expectoration returned. Sputum still negative in several examinations. With yellow oxide to the lid and hydriodic acid internally, her general condition is again improving, the swelling growing smaller, but extending somewhat along the lower lid.

Four inflamed chalazia were scrubbed with alcohol, incised and curetted, and the contents examined, with the following results: (1) Abundant staphylococcus aureus in smear and culture; (2) abundant staphylococci in smear, no culture; (3) no smear, xerosis only in culture (this was a large one, full of fluid pus); (4) no organisms in smear, culture unsatisfactory.

Six styes similarly treated showed staphylococcus aureus only in smear and culture in four cases, and staphylococcus only in smear; no culture in the other two. The last case had an acute purulent conjunctivitis with the most intense redness of the bulbar conjunctiva opposite the opening of the stye on the lid. In one of these cases the recurrence of the styes, which had been returning regularly for some months, was stopped by yellow oxide ointment and boric solution. One abscess of a Meibomian gland, from which no smear was made, showed five colonies of S. albus in blood serum culture.

Summary.—Of 70 cases of conjunctivitis, staphylococci, the Koch-Weeks bacillus, and the diplobacillus of Morax and Axenfeld were found in 34, practically one-half the cases. The xerosis was found in 8, no organisms in 12, 4 doubtful,

and other germs in 12. In 9 cases of corneal infection, streptococci were found 3 times, staphylococcus, pyocyaneus bacillus, and mould once each, and 3 indefinite. The pneumococcus and the streptococcus are again the prominent germs in the lachrymal cases; in 9 cases the former was found 3 times, the latter 4, 3 of these in lachrymal abscesses. In infections of the lid the staphylococcus aureus largely predominated. In 16 cases no organisms could be found to account for the infection, and in 6 the bacterial record is unsatisfactory.

In mixed infections, where two or more organisms were found in considerable number, these are mentioned in the description of the case; but in making up the table these cases are classed for convenience according to the predominating organism and the other germs put in the "associated" column. Organisms so few as to be presumably adventitious are not mentioned at all.

TABLE OF ORGANISMS FOUND.

	Alone or Predominating					Associated
	Conjunctival	Corneal	Lachrymal	Other Cases	Total	
Pneumococcus	4		3		7	
Gonococcus	5				5	
Streptococcus	1	3*	4	1	9	1
Staphylococcus	12	1			24	
Morax & Axenfeld Diplo-B.	10				10	
Koch-Weeks Bacillus	12		10		12	
Tubercle "				1	1	
Pyocyaneus "		1			1	
Bacilli of Xerosis Group	8			1	9	10
" Subtilis "					0	4
No Organisms Found	12	2		2	16	
Unidentified Bacilli	2				2	6
Exam. Unsatisfactory	4	1	1		6	
Mould		1			1	
Total	70	9	9	15	103	

* Associated with the Bacillus Mucosus Capsulatus in one case.

Of the associated organisms, the xerosis was found once each with the pneumococcus, the gonococcus, the Koch-Weeks bacillus, and the diplobacillus, twice with the strep-

tococcus, and four times with the staphylococcus. Organisms of the subtilis group occurred four times, but in no case as the probable cause of infection; once each with the streptococcus and the diplobacillus, and twice with the staphylococcus. The staphylococcus and streptococcus occurred but once together. Unidentified bacilli were found with the streptococcus twice, with the staphylococcus three times, and with the diplobacillus once. Altogether the xerosis group occurred nineteen times, nine of these alone. It is an open question what part, if any, they play in such cases.

Nearly half of the cases were from the clinic at the Manhattan. The most noticeable differences between these and the Bridgeport cases were in the twelve Koch-Weeks infections: only one of these occurred in Bridgeport. This very strikingly confirms our former observation that, while Koch-Weeks conjunctivitis is comparatively common in New York; it is quite rare in Bridgeport, only fifty-six miles away.

A RARE CASE OF THROMBOSIS OF THE CAVERNOUS SINUS FOLLOWING ORBITAL THROMBOPHLEBITIS.

By Dr. FRIEDRICH STOCKER, of Lucerne.

Abridged Translation from the *Arch. f. Augenheilk*, Vol. XLIV. 1901, Supplementary Number, a Festschrift for Dr. E. Pflueger, by Dr. Matthias Lanckton Foster.

THE symptoms of thrombosis of this sinus are:

1. Motor paralysis about the eye.

2. Pain in the region supplied by the trigeminus.

3. Those dependent on obstruction to the flow of blood from the orbital veins into the sinus: increase of intraorbital tension, œdema of the fatty tissue and of the lids, chemosis, signs of stasis within the eyeball due to compression or obstruction of the retinal vessels.

4. Disturbance of vision due either to thrombosis of the retinal veins and the consequent interference with the nutrition of the retina, or to compression of the optic nerve and its consequent atrophy.

Thrombosis of the sinus may occur:

(*a*) Spontaneously without inflammation or fever. This is known as marantic thrombosis and may be caused by nutritive changes resulting from diarrhœa, atheroma, Bright's disease, the puerperium, or the cachexia of carcinoma.

(*b*) As the result of traumatism with or without fracture of the bone; and

(*c*) From inflammation and injection, either direct or through a phlebitis or thrombophlebitis of the veins which empty into the sinus.

The last method is the most frequent and to it belongs the following case.

The patient was a woman forty-eight and a half years old whose father had died of softening of the brain at forty-two years of age and whose mother had died of apoplexy at sixty-two.

On January 14, 1895, she was struck in her left eye by a window blind, while at the same moment a cloud of dust was blown into her face and eyes which caused a burning and redness of the conjunctiva. This was followed by lachrymation and inability to read with the left eye, associated with pain which increased from day to day. During the night of the third day after the accident she felt a tearing pain in her left orbit, with headache, and she had a profuse perspiration. The temperature was not taken. The symptoms increased in intensity until the pulsating pain in her left orbit and the headache became intolerable during the night of the fifth day. The headache was much aggravated by an attempt to move the left eye. This evening the patient retired early and had another profuse perspiration.

At 5 P.M. of the sixth day Dr. Rappaz noted temperature 39°, pulse 94. Patient very much excited; still going about. Suffusion of blood at outer canthus of left eye. Eyeball markedly exophthalmic, red and a little chemotic; swelling of the conjunctiva. Pupil small; reaction bad. Eyeball very sensitive to pressure. Treatment: antipyrin and ice.

The patient passed a very bad night and was extremely excited. Because of the vomiting and of the intense monolateral headache, she believed that she was suffering from migraine, to which she was occasionally subject.

January 21st.—The swelling of the left eyelid had increased considerably and had extended to the temporal region. Erysipelas was not present. Temp. 39.9°, pulse 98. Morphine was given subcutaneously. During the afternoon of the same day the following record was made: Patient bedridden, excited. The outer region of the left eye much swollen; the skin of normal color except over a bluish-black ecchymosis about *2cm* square near the outer canthus. Marked chemosis visible between the imperfectly closed lids. Voluntary upward movement of the upper lid only 2 or *3mm.* The lid had to be mechanically raised to permit examination of the eyeball. Exophthalmos great; cornea normally transparent. Very slight mobility of the eyeball in any direction; all movements difficult and associated with great pain. Margins of the orbit sensitive to palpation, especially

toward the outer canthus. No fluctuation to be felt. No pulsation of the protruding eyeball. Right eye normal.

The ecchymosis at the left outer canthus naturally suggested that a contusion had caused an intraorbital hemorrhage and a subsequent infectious inflammation of the contents of the orbit, which had produced the exophthalmos together with the other concurrent symptoms. But at that time little could be learned from the patient regarding the details of the commencement of the trouble,—these had to be obtained later.

The pupil was moderately dilated, and all three reactions were very slow.

The media were clear and there were no changes in the fundus except that the veins were rather large, the papilla rather red, and its margin slightly hazy. The vision could not be determined because of the condition of the patient.

January 22d.—Morning temp. 38.80, pulse 96. In the afternoon the patient was apathetic rather than somnolent. The swelling about the left eye had increased and involved the temporal fossa more than on the previous day. There was a pasty œdema over the entire temporal bone. The exophthalmos was extreme, in consequence of which the eye was immovable and could no longer be covered by the lids. Palpation of the orbital margin revealed a place at the site of the ecchymosis so tender that the patient shrank away in spite of the morphine and apathy. The great tension made it difficult to determine whether the skin was adherent to the bony margin or not, but it seemed to be attached to the periosteum.

The patient was anæsthetized and I made a horizontal incision about 3*cm* long through the infiltrated place down upon the bone, beginning at the outer canthus. A few drops of thick pus escaped from the necrotic subcutaneous cellular tissue. No bare bone could be felt with the probe. The wound was then carefully enlarged so as to expose the outer wall of the orbit for a depth of about 3*cm*. It was then irrigated with a warm 1:2000 bichloride solution, a drain of iodoform gauze introduced, and a dressing applied.

The wound was dressed on the following morning. The gauze drain had imbibed a slight amount of pus. Temp. 39°. Pulse 100. Right upper lid somewhat swollen.

In the afternoon the picture had greatly changed. The left eyeball was somewhat less protuberant and the lids were less

tense, while the right eyeball had become so protuberant that the lids could not be closed over it and was immovable. Chemosis was present. No pulsation of the globe. Temp. 39.2°, pulse 92.

I felt no doubt now that the process began as a phlebitis in the left orbit, which had extended through the cavernous sinus to the veins of the other orbit and so had produced an exophthalmos of the right eye, and therefore I pronounced the diagnosis to be infectious thrombosis of the cerebral sinus and the prognosis to be bad. On this day the dressings were changed twice, the wound irrigated each time with warm bichloride solution. Both corneæ were anointed with a 4 % mixture of aristol and vaseline to guard against erosion. Morphine and phenacetine were given to control the pain. The vision of the left eye had fallen to movements of the hand at about 50*cm*, while that of the right was still about $\frac{1}{2}$.

On the following day, Jan. 4th, Professor Pflüger confirmed my diagnosis and recommended enlargement of the wound and the introduction of a glass drain into the left orbit, which was accordingly done.

The ophthalmoscopic condition in the left eye at this time was: Extensive œdema of the retina, particularly below and outward. The arteries were of normal calibre, the veins somewhat dilated, the margins of the papilla obscure, but there was no choked disk and no hemorrhages in the fundus. Vision had fallen to perception of light. Pupil dilated and fixed. In the right eye there were no special pathological changes, with the exception of somewhat enlarged veins and a hyperæmia of the papilla greater than physiological. The papilla was not prominent. The vision was the same as on the day before, while the eyeball had become almost immovable and the chemosis had become very marked. Prof. Pflüger considered the prognosis extremely bad. The general condition of the patient was bad and with the temperature 39.5°, and pulse only 88, seemed to indicate commencing intracranial pressure.

On the following day, Jan. 25th, I was astonished to find improvement. The temperature was 37.6° in the morning, 38.2° at 3 P.M., and 38.4° in the evening without phenacetin. The general condition was not much better, but the exophthalmos on the right side had decreased and there was a slight mobility of the eyeball. The left eye also was less prominent, while the upper lid again presented folds and could be moved by the patient

without trouble. The wound appeared much better. The necrotic portion of the subcutaneous cellular tissue had come away and had left red granulations in its place. The irrigating fluid returned discolored only slightly.

Treatment: quinine sulphate 0.25 t.i.d., and morphine muriate 0.01 subcutaneously.

Jan. 26th. Temperature 8 A.M., 37°; noon, 36.3°; 4 P.M., 37°; 8 P.M., 36.4°. Jan. 27th. Temperature 8 A.M., 36.5°; noon, 36°; 4 P.M., 36.9°; 8 P.M., 36.6°.

Ophthalmoscopic examination. Left eye: Great retinal œdema. The margin of the papilla sharply defined only on its nasal side. No trace of hemorrhages. Exophthalmos still great, movements of the eye very limited and painful. Right eye: Exophthalmos and chemosis better. Patient can voluntarily raise the upper lid. Nothing of importance to be seen in the fundus except some hyperæmia of the papilla. Vision $\frac{1}{4}$. General condition also much better.

On Feb. 6th, when I next saw the patient, she was out of bed and feeling like herself. The retinal œdema of the left eye had decreased considerably so that the retinal vessels could be seen very well except in the lower-outer portion. The papilla was pale and sharply defined. No traces of present or past hemorrhages. The direct papillary reflex was extremely slow, while the consensual and accommodative reflexes were good. Central vision was lost, the peripheral reduced to qualitative perception of fingers at 50*cm*. The motor apparatus was not yet normal, but voluntary movements were no longer painful. The wound was clean and granulating. Only a slight degree of exophthalmos remained. The right eye still protruded slightly and its movements were somewhat restricted, but otherwise it was normal. Strychnine and electricity were prescribed in the hope of obtaining an improvement in the vision of the left eye.

Feb. 28th.—Left eye: Movements limited in all directions. Some injection of the conjunctiva. The direct pupillary reflex almost wanting with ordinary daylight, very slow with a 10-candle-power electric light. Optic disk pale, lamina cribrosa plainly visible, arteries and veins rather small. An irregular thin, gray band of retinal cloudiness, 2 p. d. wide in its middle, in the outer part of the fundus. Central vision lost. Right eye: Vision 1.

March 29th.—Left eye: Slight insufficiency of internal rectus.

Direct pupillary reflex and vision lost. Optic disk as before, rather small vessels, no retinal œdema, no traces of hemorrhages.

In Feb., 1898, the ophthalmoscopic condition of the left eye was as follows: Margins of nerve rather sharply defined, with a scleral ring to its outer side. Lamina cribrosa plainly to be seen. Veins small on the papilla, but apparently of normal size in the retina. Arteries $\frac{1}{3}$ to $\frac{1}{2}$ their normal size. In all parts of the fundus, but particularly below and to the nasal side, were broad white stripes with indistinct margins which corresponded in direction, course, and form to sclerosed choroidal vessels. Normal choroidal vessels could be seen here and there. In places heaps of pigment could be seen.

The patient died in 1899. No autopsy was allowed.

In this case we have a primary subcutaneous infection of traumatic origin at the external canthus of the left eye, which, without the formation of a true orbital abscess, produced inflammation of the orbital veins which extended as thrombophlebitis through the orbit toward the brain. The thrombosis of the left cavernous sinus passed to the right through the circular sinus, and the flow of blood through the right ophthalmic vein in the right orbit was finally stopped.

The ophthalmic veins are very tortuous, have no valves, are large, and have a very great collateral circulation. Normally the blood flows from before backward into the cavernous sinus, but Festal has shown that when the blood pressure in the sinus is increased its flow may be checked, turned forward, and directed through its anastomoses into the facial vein. When the anastomoses are insufficient, the veins become distended and transudation takes place into the cellular tissue of the orbit and so produces exophthalmos.

The affection began in this patient with a traumatism at the left outer canthus on Jan. 14, 1895. The next day there was lachrymation, inability to read well, and pain referred to the left eye and orbit. On Jan. 17th and 18th there was great pain in the orbit and in the left side of the head, associated with profuse perspiration. Apparently fever was present, but the temperature was not determined. On Jan. 19th and 20th, symptoms of intraorbital tension appeared, accompanied by excessive pain. Exophthalmos of the left

eye appeared on the morning of the 20th. The temperature was 39°, and the intraorbital tension reached its highest point. An œdematous swelling in the temporal region was noticed on the morning of the 21st. It was now certain that a severe infectious process in the orbit, associated with a high fever, had stopped the venous outflow and produced the œdema of the fatty tissue, chemosis, great exophthalmos, paralysis of the oculo-motor and other motor nerves, and the excruciating pain. It was not certain whether an abscess was present in the orbit or not, so an incision was made and two or three drops of pus were found deep in the orbit. The thrombosis of the ophthalmic vein had probably reached the cavernous sinus at this time, because on the 23d a swelling of the right upper lid was noticed, and on the afternoon of the 24th a marked exophthalmos of the right eye had developed, together with all of the circulatory and nervous disturbances present on the left side. Thus the venous obstruction had passed in two days through the left cavernous sinus, the circular sinus, the right cavernous sinus, and involved the right ophthalmic vein.

Unilateral exophthalmos would simply indicate thrombosis of the corresponding ophthalmic vein, but bilateral exophthalmos, when the thrombosing agent has not acted from the front on both orbits, must be due to thrombosis of both cavernous sinuses and occlusion of the veins of both orbits, hence the exophthalmos of the right eye, so great that the lids could not be closed over it, has a bearing on the diagnosis of the case far greater than such a symptom as a swelling of the right upper lid would have had.

During the first few days the pain was due to the local inflammation and the pressure of the orbital œdema on the filaments of the trigeminus. As the thrombophlebitis extended backward the pain increased, until it finally became extreme over the entire side of the head. At this time vomiting occurred, in all probability coincidentally with the thrombosis of the cavernous sinus, and the pressure on the nerves in and about this sinus explains the paralyses which now appeared and finally resulted in total ophthalmoplegia.

The circulatory conditions within the eyes and the oph-

thalmoscopic pictures presented during the attack and three years later are very interesting. At first nothing except rather large veins and an abnormal redness of the disk was to be seen in the left eye. These conditions became more marked every day until the margins of the papilla became obscure, and then an extensive œdema of the retina slowly developed, which was densest over its temporal portion, particularly below and outward from the papilla. At no time was there a choked disk, a thrombosis of the central vein, or hemorrhages in the retina. The right eye showed only large veins and a hyperæmic papilla after the exophthalmos had lasted two days, and there was only a slight, transient œdema of the retina.

A study of the anatomical conditions reveals that even when the cavernous sinus and the ophthalmic veins are occluded a considerable amount of the blood from the central retinal vein may escape through its anastomoses with other veins, and if the quantity of blood which enters through the central artery is reduced by the great increase of the intraorbital pressure it can be understood how this smaller quantity of blood may escape without inducing a choked disk. Hence the presence of a choked disk is not to be overvalued as a diagnostic indication of sinus thrombosis, or of thrombosis or thrombophlebitis of the orbital veins, while it is important as the almost constant accompaniment of brain tumors. The œdema of the retina, the redness of the papilla, and the indistinct margins of the latter are satisfactorily explained by the long-continued increase of intraorbital pressure and the compression of the vessels. The thrombosis or non-thrombosis of the central vein in such a case depends on the peculiar, variable anatomical conditions.

The vision of the eye first affected slowly passed away and did not return after the subsidence of the acute symptoms. That of the other eye fell to $\frac{1}{2}$ and later returned to 1, but the patient always claimed that her vision was not as good as it had been before the attack. The ophthalmoscopic picture of the left eye for three years after was that of a pressure atrophy of the optic nerve. The long-continued compression of the orbital vessels in and about the optic nerve had re-

sulted in exudation, interfered with nutrition, and produced atrophy.

The fever was of a slightly remittent character without the hectic type of certain septic fevers. The temperature curve was somewhat interfered with by administration of phenacetin, but resembled that of a staphylococcus phlegmon. The pulse, as a rule, corresponded to the temperature. The general condition of the patient was bad. The pain, which steadily increased until it became unbearable, stamped the disease as very serious. Vomiting occurred either as the result of the pain or as a symptom of cerebral irritation. The latter idea is favored by the great excitement of the patient on the afternoon of the same day. On the same day she passed into a state of apathy which increased to somnolence and persisted for four days. This apathetic somnolent condition corresponded exactly to the time of the exophthalmos of the second eye, when the sinus thrombosis had become perfected and the pulse and temperature indicated commencing intracranial pressure. As the exophthalmos of the second eye retrograded, the temperature and pulse became better and the general condition slowly improved.

The prognosis of infectious thrombosis of the cavernous sinus is extremely bad, and this case is unique as the first one recorded of recovery from thrombosis of both cavernous sinuses caused by infectious thrombophlebitis in one orbit with subsequent occlusion of the veins in the other. This recovery may be explained in three ways. We may assume that the purulent thrombophlebitis extended with its toxines and bacteria into the sinus and the other orbit, but was overcome in a peculiar manner by a rare vitality and power of resistance on the part of the phagocytes of the patient, and that the surgical procedures had little to do with the result; or that the infectious thrombosis advanced into the sinuses and the other orbit, and that the resistance of the normal tissues sufficed because the primary focus had been surgically removed at the right time so that subsequent impulses to the infecting material were prevented; or, third, that the purulent thrombophlebitis of the smaller veins of the left orbit was transmitted through the ophthalmic vein to the left sinus,

and that this resulted in the coagulation of the blood in the circular sinus, the right cavernous sinus, and the right ophthalmic vein without the presence of microbes or of their products, forming an aseptic thrombus. The last theory seems to the writer the most probable. At the same time he is strongly of the opinion that the timely opening of the primary focus of infection in the left orbit was of great importance in determining the recovery of the patient.

ABSTRACTS OF ARTICLES IN VOL. XLII. OF THE GERMAN EDITION, 1900, NOT PREVIOUSLY TRANSLATED.

By Dr. MATTHIAS LANCKTON FOSTER, New York.

I.—Examination of the Eyes of 2500 Workmen in Various Industrial Pursuits. A Contribution to the Study of Injury to the Eyes by Individual Trades.

By Dr. **WALTHER**, of Charlottenberg.

THE result of the inquiry conducted by Dr. Walther with the assistance of Messrs. Overweg and Haselberg was that 611 out of 2672 workmen were found to have their vision more or less imperfect. In 387 the cause of the impaired vision was congenital, in 224 acquired. In 95 of the latter the occupation could be held responsible for the diminution of vision. The ratio of the congenital bad vision to the acquired was 63.3 to 36.6. 15% was due to occupation. There were 775 workmen under 23 years of age of whom 109 had impaired vision from congenital causes, 26 from acquired, 11 due to occupation. Here the ratio of the congenital to the acquired was 80.7% to 19.2%, only 8.1% due to occupation. With advancing age the number of persons with impaired vision due to occupation increased. In some callings injurious influences are present which gradually impaired the vision, such as the myopia developed among typesetters, gold-workers, carpet manufacturers, mechanic and allied trades, the injuries met with among metal workers, the conjunctival catarrh of cabinet-makers and furniture polishers, and the dazzling of glass-cutters, even though the diminution of vision might be only transient.

Not a single case of contagious disease was met with.

Nine workmen were met with who had been blinded or had lost an eye as the result of injury due to occupation.

II.—Sarcoma of the Choroid which Resulted in Phthisis Bulbi.

By Dr. **HEINRICH SCHULTZ**, of Berlin.

Anna G., twenty-six years old, sought relief Feb. 18, 1899. The patient, who had always enjoyed good health, noticed during the summer of 1898 a shadow which gradually increased in size before her right eye. Toward the end of the year the eye became almost totally blind within a few days. It had received no injury, was neither inflamed nor painful, and the condition had since then remained unchanged.

Feb. 18, 1899.—Right eye: Excentric vision, counts fingers at ¼ *m* toward the outer side. Inner and upper part of visual field defective. Emmetropia. Eyeball normal externally. Detachment of the retina to the outer side and below, extending close to the papilla, sharply defined and abrupt. No undulation or folding of the detached retina to be seen. Tension normal. Left eye normal with perfect vision. Diagnosis: subretinal tumor. Treatment: KI and sweating. Patient kept under prolonged observation.

The detachment gradually increased in height and breadth, and in the early part of March presented extensive subretinal hemorrhages which gradually extended and rendered the diagnosis of a tumor still more probable. After some weeks the treatment was discontinued as useless. The vision fell to movement of the hands excentrically outward. Enucleation was declined and the patient returned home about the end of June.

On July 25th, while the patient was at work in the field, a severe inflammation of the right eye set in with intense pain without any external cause. It was treated with leeches, ice, and drops. On Aug. 14th, she returned to the clinic. The lids of the right eye were still red and swollen; there was a moderate exophthalmos, chemosis, hyphæma, great injection of the globe, minus tension, and tenderness to pressure. Vision was lost. The patient stated that the redness and swelling of the eye as well as the pain had decreased considerably, although there were still occasional attacks of severe pain. Atropine, cocaine, and warm applications were ordered. The inflammatory symptoms gradually

subsided until on Oct. 2d they had disappeared together with the attacks of pain. The globe was much shrunken, soft, and tender. The cornea was depressed and cloudy. Nothing could be seen of the iris or pupil. Enucleation was performed Oct. 3d. The globe was adherent in many places to Tenon's capsule. No recurrence in the orbit as late as April, 1900. Left eye remained sound.

The macroscopical examination showed that the greater part of the posterior segment of the eyeball was occupied by a tumor which measured *7mm* in its longest diameter. The microscopical examination revealed atrophy or great degenerative changes of all the tissues of the eyeball, with the exception of the lens, and an almost totally necrotic round-cell sarcoma of the choroid. No micro-organisms were present in the eye.

III.—Postoperative Conjunctivitis and its Bacteriological Condition.

By. Dr. **G, ABLESDORF** and Dr. **NEUMANN.**

Three cases of extraction of senile cataract. In the first the anterior chamber failed to re-form, and a severe reaction with a considerable quantity of grayish-yellow mucous secretion was noted on the fifth day. The treatment instituted consisted of atropine, sublimate cleansing, and ¼ % zinc, with a bandage at night. Fourteen days later there was still no anterior chamber and the iris had begun to prolapse. This prolapse of iris was abscised three days later. After the lapse of two weeks the anterior chamber was of normal depth. The inflammation and secretion persisted until the patient passed from under observation on account of pneumonia, about two months after the operation.

In the second case the incision had closed and the anterior chamber re-formed two days after the operation. There was only a slight ciliary injection, but a severe inflammation of the conjunctiva was present with an abundant mucous secretion. The treatment instituted was scopolamine, ¼ % zinc, cleansing with sublimate, and a bandage at night. The case progressed very favorably, and was discharged twenty-seven days after the operation on the first eye, sixteen days after the operation on the second.

In the third case the first cataract was extracted without

the production of any bad symptoms. The second cataract was removed eleven days later, and this operation was followed by a violent attack of inflammation associated with a very abundant secretion.

In each case diplococci were found in the conjunctival secretion which were identified as the diplococcus albicans tardissimus.

IV.—A Stereoscopic Ophthalmoscope.

By Dr. **WALTER THORNER**, of Berlin.

This article must be read in the original.

V.—Subconjunctival Injections with Acoin.

By. Dr. **G. HIRSCH**, of Halberstadt.

The most important property of acoin is that of subconjunctival anæsthetization. Hirsch details his experiences with it in connection with injections beneath the ocular conjunctiva of solutions of cyanate of mercury, 1:2000 and 1:3000, for irido-cyclitis, threatened panophthalmitis, and parenchymatous keratitis, as well as injections of a 5 % salt solution for detachment of the retina, removal of remains of cataract after the operation for myopia, and for fluid vitreous. In all of these cases the injections were painless.

VI.—Contributions to Ophthalmology.

By Dr. **G. VINCENZ FUCALA**, of Vienna.

The first part of this article is devoted to Averrhoes, who is said to have been the first to recognize the retina as the portion of the eye which was sensitive to light. The second part is devoted to the history of belladonna and mydriatics, which are said to have been introduced into ophthalmic practice by Richter in 1785, but according to this author belladonna had been known and used from the most ancient times under the name of mandragora.

VII.—Two Cases of Syphilitic Papules on the Ocular Conjunctiva.

By Dr. **RUDOLF SCHREIBER**, of Vienna.

Case 1.—Woman forty-five years old, entered hospital April 12, 1900, with extensive venereal gangrenous sclerosis of and

about the vulva, ulcerated papules in the genito-crural fold and on the buttocks, ulcerated patches on the lips, and eczema of the hands and forearms.

Toward the end of April she complained of a burning and itching in her left eye. On the ocular conjunctiva above the cornea there was a circumscribed place with distinct conjunctival injection, which a few days later developed into a nodular efflorescence as large as a hemp-seed, grayish-white in color. On May 14th, there was an ulcer at the inner canthus of the left eye, covered with a scab. The outer parts were normal, the lower palpebral conjunctiva pale. Along the margins of the upper lid were three little ulcers with lardaceous coatings and the conjunctiva was red. The ocular conjunctiva was pale, except above, where there was a very circumscribed conjunctival and dusky ciliary injection. In this region, about $\frac{1}{2}$ *cm* above the corneal margin, was a grayish-yellow nodule which protruded from the conjunctiva, with a lardaceous covering on its surface and presenting no signs of degeneration. The injection was confined to vessels arranged concentrically about this nodule. The only subjective symptom was a slight feeling of the presence of a foreign body, which caused no trouble or irritation. The cornea, globe, and fundus were normal. The papules disappeared after the patient had been placed on general treatment.

Case 2.—Woman, twenty-one years old, who had suffered when a child from inflammation of the eyes, probably from eczematous conjunctivitis. When she came under treatment, April 23, 1900, she had eroded papules on her external genitals, the left angle of her mouth, and in her nostrils. On the lower lid of her right eye at the inner canthus was a small purulent ulcer which slightly involved the upper lid. It was not painful and caused no signs of irritation. Eight days later there were in the ocular conjunctiva, some at the limbus and some at a distance from it, grayish-white nodular infiltrates with circumscribed conjunctival injection. The next day these had increased in size and new ones had appeared. On May 14th the condition of the right eye was as follows: Moderate photophobia, palpebral fissure narrowed. At the inner canthus, mainly on the upper lid but involving a small part of the lower, there was a shallow, sickle-shaped ulcer with grayish floor and margins. The conjunctiva of both lids was red. The plica semilunaris and the conjunctival fold were greatly swollen. The peripheral parts of the bulbar

conjunctiva were slightly swollen, with marked conjunctival and slight ciliary injection. The portion about the cornea for a breadth of about 5*mm* was swollen, brawny, and deeply injected, particularly in its lower part. In this were seven nodules varying in size from that of a hemp-seed almost to that of a lentil. The nodules protruded plainly from the surface of the conjunctiva and were of a grayish-white or a grayish-yellow color. The epithelium of most of them were eroded at their apices, and the one at the outer limbus, which partially involved the cornea, was ulcerated, the base of the ulcer grayish-yellow and brawny. The cornea appeared to be normal, with the exception of central maculæ, to which superficial vessels extended. The anterior chamber was of normal depth, the iris and fundus normal. The right preauricular gland was indolently enlarged; the left eye was normal.

The treatment of the syphilis was local at first, but on May 16th general treatment was instituted, which brought the eye back to its normal appearance in about a month.

VIII—PATHOLOGICAL ANATOMY OF SECONDARY GLAUCOMA AFTER SUBLUXATION OF THE LENS.

By Dr. **G. ISCHREYT**, of Libau.

The eye was that of a man fifty years old who had received a blow on his right eye about a year before. It was enucleated because of glaucoma.

The eyeball, which was somewhat pyriform from distention of the cornea and neighboring sclera, was placed in weak formol, hardened in alcohol, and embedded in celloidin.

The ocular conjunctiva was thickened, its veins dilated, the arteries of fairly normal calibre with occasional thickening of the intima, its tissue infiltrated with mononucleated round cells, especially near the veins. The infiltration was greatest in the subepithelial zone. Numerous round cells lay between the epithelial cells.

The epithelium of the cornea was thicker than normal, irregular, and contained round cells. Beneath it was a marked round-cell infiltration which involved Bowman's membrane and the upper layers of the parenchyma. From the limbus to the region of the apex of the cornea there were numerous

vessels, chiefly in the middle layers of the parenchyma. The round-cell infiltration was most intense about the dilated vessels. Pigment was present in places in the stroma. Descemet's membrane was very thick. The endothelium was irregular, in places the cell nuclei were badly stained, in other places the cells were absent. In many sections pigment deposits were seen in the endothelium.

The endothelium of Descemet's membrane was continuous with that of the iris, and the membrane itself extended as a hyaline-like layer between the endothelium and the subjacent membrane of the iris, decreasing in thickness as it approached the pupil until it disappeared.

The anterior part of the sclera was greatly stretched; back of the ciliary body it was of normal thickness and appearance. The groove between cornea and sclera was gone. The distention was uniform, the thickness of the sclera varying from 0.22 to 0.35*mm.* It was infiltrated with mononucleated round cells. The peripheral part of the iris was adherent to the sclera. The normally narrow spaces for the passage of vessels were much broadened, a change which seemed to have been followed by an œdematous fluidity. The scleral veins were dilated; the arteries were mostly of normal calibre, with occasional thickenings of the intima. A large episcleral artery exhibited marked changes; its round lumen lay excentric in its large oval sheath.

The iris was atrophic, especially at its root, and had a firm fibrous structure with few vessels. The latter were partly obliterated, partly had thickened walls. These changes affected particularly the arteries; the veins for the most part had thin walls and were dilated. The pigment layer was irregular, with many heaps of pigment in the stroma.

An exact determination of the position of the plexus venosus ciliaris and Fontana's space was impossible on account of the greatly distended condition of the cornea and sclera.

The ciliary body was atrophic and infiltrated with round cells, the processes atrophic, a portion having undergone connective-tissue degeneration. The pigment epithelium was very irregular. The vessels were in all conditions from that of great distention to that of complete obliteration.

The lens was dislocated upward and outward.

The vessels of the choroid were well filled, the veins greatly distended. Some degenerative changes were present in the retina, but there were no signs of the presence of inflammation. Proliferations of the intima, which in places reached a high degree, were present in the posterior ciliary arteries.

REPORT OF THE MEETINGS OF THE OPHTHALMOLOGICAL SOCIETY OF THE UNITED KINGDOM.

By C. DEVEREUX MARSHALL.

CLINICAL EVENING, THURSDAY, FEBRUARY 8, 1906. CHARLES OLDHAM, F.R.C.S., VICE-PRESIDENT, IN THE CHAIR.

Messrs. ARNOLD LAWSON and GEORGE COATS showed preparations from a case of **congenital anterior staphyloma** previously brought before the Society by Mr. Lawson. The eye had spontaneously ruptured six weeks later. The central portion of the cornea was thinned and had a cicatricial appearance. The cornea was perforated with a knuckle of retina caught in it. The lens capsule and iris were adherent to the back of the cornea. Owing to stretching the ciliary processes, the pars plana, ora serrata, and anterior part of the choroid were carried forwards with the cornea. Owing to the firmer attachment of the ciliary body to the sclera, this had been left in its normal position. Thus the ciliary processes were farther forwards than the termination of Descemet's membrane, and the ora serrata was actually in front of the ciliary muscle.

Only *one other case of the kind has been described*, also in a similar case to this one. The reason of this displacement was due to the fact that in fœtal life the inner layers of the uvea were less intimately connected with the outer than is the case after birth, and the same occurs in many of the lower animals, especially in birds. The staphyloma in this case was believed to be due for certain to intrauterine inflammation and perforation of the cornea.

Mr. HOLMES SPICER showed a patient aged forty-eight who had always been **short-sighted.** The left eye had been blind ever since an injury he had received thirty years ago, and the right eye failed in 1901, and now had total posterior synechiæ and no P.L. The left eye had a corneal opacity and tremulous iris; the

lens was tilted and slightly dislocated backwards; it was quite opaque, and there was no fundus reflex. The vision was P.L. and the projection was good. On March 3, 1903, a needle was introduced behind the ciliary body, and the lens was pushed backwards. The sight was at once obtained, and it had since improved so that he was now able to see $\frac{6}{60}$. There was a large area of myopic atrophy of the choroid about the disk, and the shrunken lens was visible at the bottom of the vitreous.

Mr. Spicer also showed a case of **superficial punctate deposit on the cornea.** The patient was a girl aged sixteen, whose right eye was attacked with interstitial keratitis in 1897. She became deaf in 1902, and she had an attack of interstitial keratitis in the left eye in 1905. The latter was severe and led to much opacity and to the development of salmon patches in two places, and a deposit of keratitis punctata at the back of the cornea. The left cornea had cleared considerably ; there was some deep opacity near the centre, and numerous small brown or dirty-white dots exactly like keratitis punctata, but they were evidently close to the surface, and in front of the old interstitial opacity.

Mr. LUDFORD COOPER showed a girl aged eleven, suffering from **elephantiasis neuromatosis.** There was much deformity of the right upper eyelid and temporal region. The lid was pendulous and all its structures were greatly hypertrophied. The lid was also considerably everted. The patient was unable to lift it, and it could with difficulty be raised so that the small shrunken globe beneath it could be seen. The lens was opaque and the tension was normal. The outer and lower portions of the frontal bone and of the squamous portion of the temporal bone were much more prominent on the affected side. The condition was congenital and was slowly increasing.

Mr. E. E. HENDERSON showed a woman aged twenty-nine who had a growth on the upper palpebral conjunctiva. For several weeks she had noticed something movable beneath her upper lid, and for three days it had protruded. An oval mass was found about 2.5*cm* long and 1*cm* broad. Its surface was smooth and vascular, and was attached to the fornix by a strip of conjunctiva containing vessels. It was thought to be tubercular.

Mr. SYDNEY STEPHENSON showed a boy aged nine who had **two detachments of the retina in one eye,** one above and the other below. The tension was increased, and the vision was bare P. L. Transillumination showed that light passed readily through both

detachments. The other eye was myopic, with some vitreous opacities. There was an obscure history of injury, and a doubtful history of tubercle in the family. The question was one of diagnosis, though it was considered to be of a tubercular nature by Mr. Stephenson.

Mr. H. H. B. CUNNINGHAM showed a girl aged five whose sight was noticed to be defective at school. In both eyes the **lenses were displaced,** most marked in the right eye; the suspensory ligament was absent below. There was no coloboma in either iris or choroid. The right eye was myopic about 8D, and the left about 3D, but with some astigmatism in both.

Mr. A. STANFORD MORTON showed the drawing of a case of **staphyloma posticum verum** (Weiss).

Mr. TREACHER COLLINS showed two cases of **congenital coloboma of the iris with a bridge.** In the first case there was a bridge of pigmented iris tissue about *1mm* in breadth, stretching across the space formed by the pupil and the coloboma. It was situated a little below the level of the margin of the pupil, which was pear-shaped with the small end downwards.

In the second case the two eyes presented two lesser degrees of the same condition. In one eye the stroma of the iris was alone deficient below the bridge, the pigment epithelium being left exposed. In the other eye, the space below the bridge formed in part a complete gap in the iris, and was in part filled with pigment epithelium. The developing iris receives its blood supply from two sources: (1) loops of vessels budding off from the anterior ciliary arteries, and (2) branches continued forwards round the sides of the lens from the central hyaloid artery; these form a circle of anastomosis anteriorly. The gap in the iris peripherally in these eyes might be explained by the failure in formation of one of the loops from the anterior ciliary arteries; and the bridge, by the normal formation of the anterior circle of anastomosis from the central hyaloid artery.

Mr. ARNOLD LAWSON showed a case of **persistent œdema of the upper eyelids** in a girl aged twelve. The affection commenced about six years ago, shortly after recovery from an attack of measles which ran a normal course. Both upper lids were much swollen and drooped over the eyes, almost obliterating the palpebral fissures. The skin and subcutaneous tissue were not at all altered, and the state of the general health had much to do with increasing or diminishing œdema. The condition was strictly

limited to the upper lids, and but for its weight it did not cause any inconvenience.

Mr. LAWSON also showed a case of **concomitant divergent vertical strabismus,** with associate movements of the lids. The squint had existed since early infancy. The right eye was always used for fixation, and the left was divergent, and on a lower level than its fellow; the upper lid drooped over it so that it almost concealed the cornea from view. On screening the right eye, the left quickly moved upwards and inwards to the position of normal fixation, and the lid was correspondingly elevated. Behind the screen, the right eye deviated upwards and outwards, and the upper lid was strongly retracted. On removing the screen, the left eye and lid once more dropped to their former position. On asking the child to look upwards, the movement of the left was seen to be defective, and on attempting to look downwards, the movement of the right eye was seen to be less than the left.

THURSDAY, MARCH 8, 1906. PRIESTLEY SMITH, F.R.C.S., PRESIDENT, IN THE CHAIR.

Messrs. J. HUBERT PARSONS and GEORGE COATS read a paper on a case of **orbital encephalocele** associated with microphthalmia. Mr. Parsons had shown the child to the Society when thirteen weeks old. There were then large cyst-like masses in the right orbit pushing the globe over the outer side. The right eye was evidently microphthalmic and showed ophthalmoscopically a coloboma of the nerve entrance and also of the macula. Various diagnoses were made as to the orbital condition. As the tumor was increasing in size it was operated on, but the child died a few days later. The mass in the orbit consisted of brain tissue which pressed upon and caused deformity of the globe. It was connected with a large mass of brain substance within the skull which lay beneath the frontal lobe. The intracranial mass had displaced the latter upwards and the temporal lobe backwards, but had no connection whatever with either. It was therefore believed to be either a teratological inclusion, or a piece of brain substance snared off in early fœtal life, possibly from the region of the caudate nucleus, and growing independently.

The eye showed three deformities, each of which was rare: (1) An ectasia on the nasal side of the papilla, which still had a lining

of stretched choroid and normal retina. (2) A coloboma of the nerve entrance which was peculiar in being on the temporal side of the nerve and in being entirely within the area of the porus opticus. (3) A macular coloboma which consisted chiefly in a partial defect and depigmentation of the pigment epithelium, both the choroid and retina being almost intact. The relation between the encephalocele and the abnormalities of the globe was discussed.

Mr. PRIESTLEY SMITH described a **scotometer** for the diagnosis of glaucoma and for other purposes. It was intended to facilitate the examination of the central parts of the field of vision, especially in cases of suspected glaucoma. It consisted essentially of a disk of millboard covered with black cloth and figured on the back with the degrees of the circle. The test object was a small cutting of gray wool which was laid upon the cloth at any desired distance from the centre. In the case of suspected glaucoma it should be placed at 25° from the centre, as shown by a faint mark on the cloth, and the disk should then be slowly rotated. Should it nowhere disappear or grow dim, in all probability glaucoma does not exist, for, as Bjerrum had shown, the defect in the glaucoma field was almost always radial or sector-like, and, with a delicate test, could be traced inwards. If a defect were found, its extent should be noted on the graduated circle so that it could be used for future comparison. Other circles could be explored if necessary. The authorized maker of the instrument is Mr. Bailey, of Bennett's Hill, Birmingham.

Mr. C. WORTH read a paper on **hereditary influence in myopia.** Though often regarded as a simple error of refraction, grave complications may arise which altogether overshadow the original condition. Myopia is frequently inherited. In a series of 687 cases examined by the author, 33 were malignant and 654 were uncomplicated. Of the latter, 56 % gave a family history of myopia, while in the former in only 24.25 % was evidence of heredity found. In one family whose pedigree was shown, nearly all the males were myopic and none of the females; but the myopia was transmitted through the female line. The amount was, in all cases examined, about the same, viz: 10 to 12D with some astigmatism. The fundi showed crescents, but grave complications were wanting. Curiously enough in this family all the healthy eyes were blue, and all the myopic ones were brown. Night blindness was only admitted in one family.

The statistics of the 687 cases were as follows: Of 313 with no family history of myopia, 163 were males and 150 females. Of 374 with a family history of myopia, 228 were males and 146 females. This showed that the usual preponderance of myopia in men was increased in those in which myopia was hereditary.

Of the 374 cases in which a family history of myopia was obtained, in 159 the parents were myopic, but the myopia was present in uncle, aunt, or grandparent. The fault was on the mother's side in 104 cases, on the father's side in 33 cases, and on both sides in 22 cases.

REPORT OF MEETINGS OF THE OPHTHALMOLOGICAL SECTION, NEW YORK ACADEMY OF MEDICINE.

By Dr. H. W. WOOTTON, Secretary.

MONDAY, JAN. 15, 1906. DR. W. B. MARPLE, PRESIDENT, IN THE CHAIR.

Dr. W. B. MARPLE was re-elected Chairman.

Dr. H. W. WOOTTON was re-elected Secretary of the Section for the ensuing year.

Dr. ALEXANDER DUANE presented an **apparatus for accurately plotting central scotomata, the field of fixation, and the field of single vision.**

It consisted of a curtain 64 inches high and 54 inches broad, mounted on a light portable frame like an ordinary screen. The frame was made so as to be taken apart readily, and the curtain could be raised or lowered through a distance of ten inches. One side of the curtain was white and marked like an ordinary perimeter chart with circles and radiating lines, the circles representing 5° intervals on a tangent scale, calculated for a radius of 30 inches. The scales extended upward 36°, downward 53°, and laterally 42°. The other side of the curtain was dead black and marked only by the white head of a pin thrust through it to show where the centre of the perimeter chart on the reverse side lay. The patient being seated opposite the black surface, and just 30 inches from it, the curtain was raised until the pin was on a level with the eye.

The outlines of scotomata, the points where double vision began, or the limits of the excursion of the eye in any direction, could then be pricked off by pins, whose position, as they stuck through, was shown on the perimeter chart on the other side. A plot like this could be quickly made—more quickly than with an ordinary perimeter—and could be readily transferred to a perimetric chart. The apparatus was particularly useful in

plotting the field of double vision, in which case the amount as well as the location of the diplopia could be indicated by inserting two pins of different colors, one marking the site of the test-object, the other the site of the corresponding double image. In delimiting the field of fixation it was sometimes necessary to extend the limits of the scale laterally. This was done by a tape with a tangent scale marked on it, which carried the field out to 60° on either side.

Dr. E. COBURN suggested that when the pins in Dr. Duane's apparatus were carried through to the other side the field would be reversed, and this might cause confusion.

Dr. DUANE admitted that this was a defect, but stated that in registering his results on charts he always indicated the nasal and temporal limits. He preferred a tangential scale to the scale represented by the arc as on perimetric charts.

Dr. THOMAS R. POOLEY presented a case of **cilia in the anterior chamber.** The patient had been injured three weeks before. There was an incised wound on the nasal side of the cornea, in its vertical meridian, which had nearly healed. The eye was free from irritation, the lens uninjured, V. good. By oblique illumination two lashes were to be seen in the anterior chamber. One extended across the chamber in its vertical meridian on the temporal side near the ciliary attachment of the iris. The other, a much shorter one, had one end engaged in the corneal scar, from which it projected in the anterior chamber in its horizontal meridian. As the eye was free from irritation, it was decided to let them alone.

Dr. J. E. WEEKS presented a case of **fistula of the cornea successfully closed by a plastic operation.**

Dr. E. L. OATMAN presented a case of **melanosarcoma of the choroid with recurrence in the orbit after enucleation.** Published in full in this number of these ARCHIVES, pages 318-320.

Dr. FRANCIS VALK presented a case of **formation of the conjunctival cul-de-sac** according to the method of Dr. Weeks.

The patient met with an accident from fireworks, in which the stick of a rocket, coming down, tore out the eyeball and lower cul-de-sac of the conjunctiva, so that she was unable to wear an artificial eye. Two months ago he performed the operation for the formation of a cul-de-sac according to the method of Weeks, by attaching the Wolf's graft obtained from the arm to the perios-

teum of the outer edge of the orbit and the insertion of a rubber plate. She now has a good cul-de-sac and wears an eye with comfort.

Dr. S. PAYNE presented a case in which **enucleation had been followed by the insertion of a paraffin ball into Tenon's capsule.** The muscles had been sutured over this. The operation had been performed about a year ago. Cosmetic result was excellent and the movements extensive.

In the discussion which followed, Dr. DE SCHWEINITZ stated that he had seen a case similar to that of Dr. Pooley, in which the cilium had been in the anterior chamber for six months. It was removed to prevent formation of a pearl cyst. The cilium when removed was normal. He advised removal of the cilia in Dr. Pooley's case.

Dr. E. S. THOMSON had seen a case in which, three months after the injury, two cilia were observed partially within the anterior chamber. The cilia were removed. He believed that pearl cysts would have formed.

Dr. E. L. OATMAN stated that the removal of cilia from the anterior chamber does not always prevent the subsequent development of pearl tumors or cysts. These tumors develop from the epithelium of the root sheath, which may remain implanted in the iris after the eyelash has been removed.

In the discussion of Dr. Oatman's case of melanosarcoma, Dr. MARPLE stated that he had seen a similar case in which the evisceration had been followed by no recurrence, the operation having been performed over a year ago.

In reference to Dr. Valk's case, Dr. WEEKS stated that a flap without a pedicle would shrink for from two to three and a half months. The condition remaining at the end of about three months was permanent. Anchoring the flap to the periosteum gave the best results.

In regard to Dr. Payne's case, Dr. J. H. CLAIBORNE stated that some years ago he had experimented with various substances in Tenon's capsule. The result in Dr. Payne's case was excellent. Time alone could show what the permanent result would be. On account of the variation of the size of the pupils caused by the stimulus of the light, he thought that the cosmetic effect in these cases might be very much enhanced if the patient were to have two artificial eyes, one for use at night, and the other to be used in the day.

Dr. MARPLE had seen two paraffin balls come out, but others had stayed in.

Dr. G. E. DE SCHWEINITZ read a paper entitled **concerning the value of the visual field phenomena in the investigation of certain neuroses and psychoses.**

In the discussion which followed, Dr. T. R. POOLEY thought that a number of control examinations were necessary in these cases, and asked whether Dr. de Schweinitz had found unfavorable after-results in any of these hysterical patients. As far as he knew, no amblyopia had resulted, but it does seem incredible with such contraction of the field as is often found.

Dr. E. COLLINS stated that neurologists were uniform in their opinion in regard to the limitation found in grand hysteria and neurasthenia. In his experience these limitations occurred in only thirty per cent. of the cases. This, however, was frequently enough to give it a permanent place in the symptomatology. This being granted, what was the prognosis of the cases? Were they necessarily very severe? Did the condition persist in any degree after the hysteria disappeared? The fatigue field of hysteria seemed to him to vary so very much in the same patient at different times that one could not place as much reliance upon it as upon the contracted field of hysteria.

Dr. W. L. LEZYNSKY agreed with Dr. Collins particularly in regard to the variability seen from day to day. He thought the fields as usually taken were all very unreliable. In hysteria the concentric contraction of the field, when well marked, was about the last symptom to disappear.

Dr. DUANE stated that cases with central scotomata were often very puzzling, and one might sometimes consider a case as functional when in reality it was not so.

Dr. G. E. DE SCHWEINITZ, in closing the discussion, admitted that the field symptoms were not present in all cases, but in the twenty-five or thirty per cent. in which they were present they were a fair symptom of hysteria and an aid to diagnosis. As to the permanency of the contraction of the field of hysteria, he thought that this condition might disappear promptly when the patient recovered. It might also disappear slowly or endure for a very long time, for months, just as was the case with the three types of hysteria amaurosis.

MONDAY, MARCH 19, 1906. DR. DUANE, CHAIRMAN PRO TEM.

Dr. H. H. SEABROOK presented a case of **hyperphoria with lateral curvature of the spine.**

Dr. Seabrook stated that 20 per cent. of our refractive cases have hyperphoria and most of them throw the head toward one or the other shoulder upon fixing objects, with a curvature of the upper portion of the spinal column away from the direction of the tipping of the head.

Bad adjustment of desks in schoolrooms with regard to sunlight was another cause, while oblique parallel astigmatism of the eyes, or oblique astigmatism of the aiming eye, was comparatively unimportant as regarded lateral curvature. The aiming or predominant eye was well studied by Kaiser in 1869, and its consideration was of interest, as Dr. Seabrook had found no mention in literature of the connection between hyperphoria and lateral curvature, except a casual mention of the matter by himself in 1900. The patient whom he presented had marked deformity from about two degrees of hyperphoria. Dr. T. Halstead Myers had examined the patient and found fixed curvature in the lumbar region and much plastic curvature higher up. A tenotomy of the left superior rectus sufficient to correct the hyperphoria had resulted in causing the head to be held in a perfectly erect position, while the curvature of the upper portion of the spine (cervical and thoracic), formerly so apparent, was now not noticeable to the ordinary observer, although the patient was nearly twenty years of age.

Dr. FRANCIS VALK thought that Dr. Seabrook's case was one in which lateral curvature of the spine might very well take place.

Dr. ALEXANDER DUANE thought that wry neck and probably scoliasis could be produced by the tilting of the head by the patient to bring the hyperphoric images on a level. It could readily be found that normally, when there is homonymous or crossed diplopia, tilting of the head and one shoulder always depressed the image on that side, whether that image belonged to the right or the left eye of the patient.

Dr. EDGAR S. THOMSON presented a specimen of **carcinoma of choroid.**

The patient, a woman of forty-eight years, first came under the care of Dr. Dean Foster in February, 1904, with failing vision in the right eye. Three years previously she had had the right

breast removed. It was examined and found to be scirrhus carcinoma. The vision was at this time $\frac{20}{30}$, and there was a cloudy spot on the retina on the nasal side of the disk. Dr. Thomson saw the case in consultation a week later, when there was a flat and slightly nodular growth beneath the retina. The retina was seen best with + 5. A diagnosis of metastatic carcinoma was made and enucleation advised. On May 5th the tension became elevated and the patient had attacks of pain which gradually grew worse until July 13th, when Dr. Foster enucleated the eye. The patient lived until Feb. 23, 1905. There was an autopsy. The specimen showed the usual appearance in such cases. The retina was detached and the choroid was extensively involved by the growth. There was beginning infiltration of the optic nerve.

Dr. DIXON stated that he had recently seen a case in which the eye had been removed for supposed sarcoma which ultimately proved to be carcinoma. The invasion had taken place on the temporal side of the choroid. The patient died later of carcinoma of the lung which had not been suspected.

Dr. OATMAN said that a peculiar feature of this case was the large size of the extraocular deposits as compared with those in the choroid. The entire nerve substance was replaced by carcinomatous tissue continuous with that in the choroid. He knew of no case of carcinoma of the choroid in which the malignant embolus was first deposited in the optic nerve. The possibility of such an occurrence was merely suggested in this case by the disproportionate size of the nerve deposit. An embolus could lodge in a nerve branch of the arteria centralis or in one of the branches from a short ciliary artery which goes to the nerve.

Dr. GEORGE DIXON reported, for Dr. R. G. Reese, a case in which a broken glass Mules ball had been worn for thirteen years and then removed. The skiagraph of the broken ball in the orbit was shown. In February, 1906, the patient had gently wiped the eye and broken the glass ball. Dr. Reese removed the broken glass and inserted a paraffin ball.

The skiagraph made by Dr. Dixon showed the crack in the glass.

Dr. E. S. THOMSON had often wondered why this accident did not occur more frequently, and this case was certainly one in favor of the use of paraffin. With paraffin, if a ball proved to be too large at the time of insertion, it could be reduced in size later, and the tissues again sutured over. In Dr. Reese's case the glass ball was certainly very thin.

Dr. LINN EMERSON thought the strength of the glass ball should always be tested before insertion.

Dr. DIXON stated that he did not think that the glass had eroded in this case thus making the ball more liable to fracture, but thought that the ball had simply been a thin one at the time of insertion.

Dr. OATMAN favored the insertion of a paraffin ball in Tenon's capsule.

Dr. F. J. PARKER reported a case of **quinine amaurosis.** The patient, a male, forty-three years of age, was admitted to the Presbyterian Hospital on June 4, 1905, in a condition of stupor, irregular respiration, flushed face, occasional periods of collapse. The following history was obtained: The man had been sick with broncho-pneumonia, and on the physician's order had taken 48 five-grain capsules of quinine (total 240 grains) in twelve hours during the night of June 3d. The next morning he had delirium, noises in ears, loss of sight. When examined by Dr. Parker on June 8th, the pupils were widely dilated, no reaction to light, cornea hazy and markedly hyperæsthetic; tension —2, each eye; perception of light only. Fundus of right eye: nerve pearly white. Choroidal reflex very pale; thrombus inferior branch central vein; veins much enlarged, endarteritis of arteries, obliteration small branches, blood column broken in some branches resembling the condition in embolism. Iris dull. Left fundus same except thrombus was of superior vein.

The patient was put on hyp. strychnine $\frac{1}{60}$ once a day; increase $\frac{1}{60}$ each day to $\frac{1}{10}$. Amyl nitrite *2mm* pearls t. i. d.; nitro-glyc. $\frac{1}{75}$. q. 4 hr.

A gradual improvement in appearance and vision. The patient left the hospital on June 30, with $\frac{20}{50}$ V R and L. Choroid reflex normal, circulation restored in large arterial branches, small arteries remained obliterated. Fields much contracted.

	R.	L.
Superior,	10 deg.	10 deg.
Inferior,	30 "	32 "
Nasal,	18 "	30 "
Temple,	20 "	30 "

On October 18, 1905, the vision R and L was $\frac{20}{15}$; slight increase of fields; fundus condition the same; nerve white.

DR. LINN EMERSON read a paper entitled **some observations**

on Worth's methods of treatment of convergent squint, with presentation of cases. The following is the author's abstract:

The paper considered only concomitant convergent squint. Donders's epoch-making discovery of the causal relation of hyperopia and hyperopic astigmatism; Landolt's remark in the early eighties that there is, with the majority of those who squint, a predisposition to strabismus with whose exact nature we are not yet entirely acquainted; Worth's contention that the one true and prime cause of squint is deficiency or absence of the fusion sense. Predisposing causes are:

1. Hyperopia and hyperopic astigmatism.
2. Anisometropia.
3. Specific fevers, especially whooping-cough, measles, diphtheria, etc.
4. Violent mental disturbances (fright, fits, etc.)
5. Injury during birth.
6. Heredity.
7. Congenital defects.

Belief that congenital amblyopia is a very rare condition. Figures taken from Worth to show what occurs when fusion takes place; early development of squint, 60 % before fourth year and 90 % before the sixth year. Fusion faculty seldom develops after the sixth year. There are three grades of fusion.

1. Simultaneous macular perception.
2. True fusion with some amplitude.
3. Sense of perspective.

Alternating squint is not as amenable to treatment as the monolateral cases. The squinting eye almost invariably has the higher refractive error. Plan of treatment:

1. Optical correction.
2. Occlusion of the fixing eye.
3. Use of atropin in fixing eye.
4. Training of fusion sense.
5. Operation.

Full correction under atropin as indicated by retinoscopy. Transfer of squint to sound eye in cases where atropin has been used for a long time without proper supervision. Training of fusion by amblyoscope, stereoscope, and plastograms. Credit is to be given to Dr. Bloch for pioneer work done in this country. The treatment of a case may extend over several years. This

plan of treatment in no wise interferes with or precludes operative treatment later.

After having the case under observation for a suitable time, the surgeon may perform:

1. Simple tenotomy on one or both eyes.
2. Tenotomy and advancement on one.
3. Panas's operation of stretching and treating, or both.
4. Advancement of one or both.
5. Some one of the various tucking or folding operations.

Panas's operation as a routine procedure is poor surgery. He prefers the advancement operation of Dr. Wootton.

There is opposition from the medical profession, and even from ophthalmologists to this plan of treatment. And much less opposition now than formerly, however. The parents are more sanguine as they are able to see fifteen or twenty cases making progress every time they come with child for treatment. Acknowledgment to Drs. Van Fleet and Lewis for opportunity to treat upward of 300 cases during the past three and one-half years. **Presentation of twenty-six cases** before Section, most of whom are not cured cases, but cases still under treatment.

In the discussion which followed, Dr. FRANCIS VALK stated that there were two points in this connection to which he would like to call attention: The first, the etiology of squint, and the second, the future of these children. In regard to the etiology, he gave as an illustration a case of monocular squint. The patient fixed with the right eye. She had a hyperopia of about 5 dioptres. By placing a + 4D before the eyes, the squint at once disappeared and she seemed to have binocular fixation, perhaps binocular vision. In the light of these cases, what became of Worth's theory of fusion as the sole cause of squint? Did the glasses restore the function which is said to be absent from birth? There was evidently no restoration of fusion in this case, yet the visual lines appeared straight. An anatomical theory could better explain it. On this theory we must have an essential weakness of some muscles and, when this patient was examined as to the field of vision, the right eye rotated 60° inwards, 40° outwards, and the left eye, 45° inwards and 40° outwards. This showed a weakness of the right externus, and why did the glasses correct the squint? Because they so corrected the refractive error that the retina must receive much sharper and clearer images, and so stimulate the dormant fusion, causing

increased stimulus to the weak externus so as to bring the image of the right eye on the macular region.

This weak external rotation was always found in all varieties of squint. As to the future of Dr. Emerson's cases, they had little obvious squint, but if they recovered binocular vision as they grew older, would they not, when they began to take up the serious work of life and use the eyes for steady work, suffer from esophoria? It would take many years to tell whether this would happen or not. A case he had recently seen had brought this forcibly to his mind. The case had been cured by correcting the refractive error some twelve years previously, and the vision had improved to $\frac{10}{10}$ in each eye with full correction, but now the patient is sixteen years of age and has more or less muscular asthenopia when she studies, and the necessity of operation has presented itself. Time alone would tell what was the future of cases of convergent squint corrected by glasses. His own view at present, in the treatment of this condition, as it is due to an essential weakness, is to shorten one or both externi, and then to try to develop binocular vision and fixation with such aid as Dr. L. Emerson had so ably placed before the Section.

Dr. H. H. SEABROOK doubted whether the fusion faculty could be restored by Worth's method. He also doubted whether the amblyopia of the squinting eye could really be improved to any great extent, but called attention to the fact that quite a number of cases recovered binocular single vision after binocular fixation had been secured by means of glasses or by glasses and operation without any form of subsequent stereoscopic exercises. In other words, as the Worth treatment failed in a certain number of cases, he doubted very much whether any greater success was obtained by it than by the methods thus mentioned.

MONDAY, FEBRUARY 19, 1906. DR. WILBUR B. MARPLE IN THE CHAIR.

Dr. EMIL GRUENING presented a case **showing result of Kilian's operation for frontal sinus disease.** The patient, seventeen years of age, presented himself at Mount Sinai Hospital on Feb. 2, 1906, suffering from empyema of the left frontal sinus. The corresponding eye was dislocated downward and forward, immovable; the swollen lid could not be raised. Sight normal; ophthalmoscopic examination negative. From the nose, copious

discharge of pus, oozing from a point situated between the middle turbinate and outer wall of the nose.

Operation according to Kilian. The anterior wall of the frontal sinus and its floor were removed, also the nasal process of the superior maxillary bone, establishing drainage from the floor of the frontal sinus directly into the nose. The whole wound was closed by interrupted sutures. Next day patient had temperature of 103°; right side of nose showed circumscribed swelling. Erysipelas. Redness and swelling extended over right side of face, without encroaching upon the sutured wound. The erysipelas ran its course in five days. The sutures were removed on the sixth day. The wound had united by first intention.

Dr. Gruening presented this case because it demonstrated: 1st. That the removal of the whole anterior wall of the frontal sinus does not result in disfigurement of the face. 2d. That the detachment of the periosteum of the roof of the orbit does not cause a muscular disturbance and diplopia. The operation of Kilian is an extension of the operation practised by Jansen. Jansen removes the anterior wall and floor of the sinus; Kilian does the same, but adds the removal of the nasal process of the superior maxillary bone, removes the middle turbinate, and establishes free drainage between the frontal sinus and the nose. Everything that has been claimed for this operation has been obtained in this case.

Dr. J. E. Weeks inquired as to the necessity of removing the roof of the orbit and also the necessity of removing so much of the nasal process. He had seen cases in which less had been removed do very well.

Dr. Gruening, in replying, did not think that the complete Kilian operation was necessary in all cases. The roof of the orbit, however, should always be removed, for it is always found softened and necrotic. The removal of the nasal process established a communication with the nose, allowing the external wound to be closed.

Dr. T. R. Pooley thought the roof of the orbit should pretty generally be removed, depending, of course, upon the extent of the disease. The operation should always remove the entire diseased tissues.

Dr. C. W. Cutler presented a case of **acute glaucoma operated by Heine's method of cyclodialysis.**

He called attention to two methods which, in the light of

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further observation may or may not prove to be of permanent value.

There was as yet no evidence as to their efficacy, but he stated that they seemed harmless, and as they are both supported by certain theoretical considerations, it seemed wise to call attention to them so that, by wider use, conclusions as to their value might be sooner reached.

Cyclodialysis was described by Heine at the last meeting of the Ophthalmological Gesellschaft at Heidelberg; a brief abstract of his paper and the discussion may be found in the *Zeitschrift für Augenheilkunde* of October.

The operation consists in making a small incision through the sclera, 5 or *6mm* back of the limbus and without incising the deeper tissues, passing a small blunt instrument, such as a spatula or a probe, forward through the suprachoroidal space into the anterior chamber. The aqueous escapes through the wound, and the probe may be gently moved from side to side, in order to open the angle.

In a recent case of acute glaucoma, T+2, wide pupil, shallow anterior chamber, in which iridectomy would have been difficult, a conjunctival flap was raised and an incision about *2mm* long made in the sclera, *5mm* back of the limbus; a small blunt probe passed easily forward and appeared in front of the iris in the anterior chamber, aqueous escaped, and the tension fell. A single stitch drew the conjunctival flap over the wound, and the eye was bandaged. There was very little pain at the time of the operation, no hemorrhage into the anterior chamber, and no reaction followed. *Tension remained normal for a week, then rose suddenly.* The operation was repeated through the same passage, but, as it seemed to promise no permanent relief in this acute case, an iridectomy was performed and tension has since remained normal.

In less acute cases, where the lens and congested ciliary processes were not pressed forward, it might have a more lasting effect, but it seemed to him that its chief value was as a preliminary operation to iridectomy where the anterior chamber is shallow, and if the coloboma can be placed at the point where the angle has been opened, the chances of maintaining a patent filtration angle will be greatly increased. It is probable that few of the attempts made from the anterior chamber, such as ant. sclerotomy or Vincentiis operation, reach the ligamentum pectinatum,

and even in iridectomy the root of the iris is seldom reached, so that it is still a problem how it acts, and why it is so often successful.

Dr. C. W. CUTLER also presented a case showing **treatment of gonorrhœal ophthalmia by Torrey's serum.**

He had begun the use of anti-gonococcus serum made by Dr. John C. Torrey at the suggestion of Dr. John Rogers, at the Foundling Hospital, but there were not yet enough cases to make a report worth while.

It is obvious that a large number of cases of all types must be treated by any remedy before conclusions can be reached, and the more varied the point of view, *i. e.*, the larger the number of observers, the better. Nitrate of silver retains its precedence; argyrol has not, in his experience justified the rather extravagant claims made by its advocates and he no longer relied on it exclusively, even in apparently mild cases.

Dr. CUTLER was glad to read Dr. Verhoeff's statement to the same effect in his article on sodium aurate in the same number of the *Journal of American Medical Association.* No one will assert that the present treatment of gonorrhœal ophthalmia is satisfactory, and the experimental use of this serum is desirable. The prospects are perhaps not very promising, for although it has been of great service in gonorrhœal rheumatism, it has been used practically without effect in acute urethritis. Dr. Torrey thinks that this is due to the large number of cocci in the latter condition, and to the fact that they are practically outside of the body and inaccessible to a serum given subcutaneously. Dr. Cutler has given it to two infants hypodermically, and has dropped it into the eyes without any reaction or pain. Both recovered. One was a moderately severe case, and seemed to improve after each injection. The routine treatment was continued, however. The nature of the serum and its mode of production are described by Dr. Torrey and Dr. Rogers in the *Journal of the American Medical Association*, of January 27, 1906, and Dr. Torrey will be glad to provide the serum for those wishing to use it, and will appreciate any reports that may be made to him.

Dr. GRUENING asked what had been the vision in Dr. Cutler's case of glaucoma before and after the operation.

Dr. CUTLER replied that the patient had a cataract and the vision was nearly abolished before the operation. It improved after operation but fell again after the second attack, to improve

again after a subsequent iridectomy. He thought the operation more advisable as a forerunner of an iridectomy to free adhesions. The cases were observed for several months after the operation and it apparently did no harm.

Dr. J. E. WEEKS presented a case in which he had **restored the lower cul-de-sac by means of Wolfe's grafts.**

The patient, a man forty-three years of age, had his right eye enucleated some years ago and an artificial eye was worn until some six months ago when the lower cul-de-sac became obliterated and the artificial eye could not be retained. A plastic operation for restoration of the sac was performed, a Wolfe graft being employed, and the lower border of the flap being anchored to the periosteum. The operation was performed two weeks ago and the result is re-establishment of a cul-de-sac nine millimetres in depth. The flap healed perfectly.

Dr. WEEKS presented this case as the fourteenth successive operation of this character with complete success.

Dr. A. SCHAPRINGER read a paper entitled **congenital word-blindness in pupils of the public schools.**

Among the pupils of public schools who applied at Dr. Schapringer's class at the German Dispensary "to be fitted with glasses," several were found who were backward in learning to read because they were "congenitally word-blind." They were usually emmetropic, sometimes hypermetropic. These children usually succeed in learning to pronounce the single letters of the alphabet at sight, but have difficulty with syllables and whole words. Dr. Schapringer pointed out a quick way of establishing the diagnosis of "congenital word-blindness." After making the child read the letters on an ordinary Snellen chart and noting the promptness with which this is accomplished, he makes the child call out the figures (numerals) on another Snellen chart. If the child calls out the figures more promptly than it did the letters, the case is diagnosed as one of "congenital word-blindness." Our knowledge of this defect is the result of the labors of W. Pringle Morgan, James Hinshelwood, Edward Nettleship, and Otto Wernicke, a brief résumé of whose publications was given by Dr. Schapringer.

Pure uncomplicated "word-blindness" cannot occur in China or in any of those countries which have adopted the Chinese method of writing, which is not alphabetic, but "ideographic."

Dr. J. H. CLAIBORNE read a paper entitled **concerning types of congenital symbol amblyopia.**

The following is an abstract by the Secretary:

Dr. Claiborne referred particularly to two cases in which he considered that there was congenital deficiency, or at least a tardy development of the word memory-cells. He thought that congenital word-blindness was a department in pediatrics and neurology which had not received the attention which it deserved.

The first case, a boy of ten years of age, was seen on account of an injury to his left eye, but the injury had no bearing upon his other symptoms. While examining him, Dr. Claiborne was struck by his slowness and peculiarity, and the mother stated that he had never been able to learn how to read; he could write a few simple words. At times he named some of the letters of the alphabet correctly; later on he failed to rename the same letters. When asked to write certain letters of the alphabet he made repeated errors. For a capital K he made a capital T; for a capital T he wrote little t, and he could not write u at all. Although he wrote a K for a T, when asked to write K he could not make it, but when asked to write his name he did so with readiness. Dr. Claiborne believed the name was written automatically. The letter E seemed to have great difficulty for him. At times he called it S, at other times correctly. Although he wrote his name correctly, he could not recall the letter E in it, although he had written it. His refraction was about emmetropic, but no accurate test of vision could be made, as he was never certain about the letters. His field of vision was normal and he was right-handed. In other respects he was rather bright, understood words and commands, knew the meaning of ordinary words, recognized objects and their uses, and, according to his mother, was talkative, communicative, and even garrulous at times; played with other boys in the street in a normal manner. His inability to learn his letters accurately, his consequent inability to remember and recognize words, smacked of just ordinary ignorance, and there was a strong temptation to dismiss the case by calling the boy a fool, but his obvious general intelligence about objects, his normal power of recognizing the meaning of spoken words, and obedience to commands that involve other things than writing, saved him from this criticism. He is abnormally simple in respect to reading written words or letters. His word-blindness was not for

other written symbols, for he easily recognized and correctly called figures. The case was then distinctly anomalous, and was distinctly not one of word-blindness, for he bore some marks of motor aphasia.

His condition was really one of word-amblyopia for written and printed alphabetical signs or symbols. The lesion was doubtless a congenital one and probably consisted in imperfect development and tardy reaction of the word and letter memory cells. The lesion was probably in the cerebral cortex, in the region of the angular gyrus on the left side, seeing that the boy was right-handed.

Dr. Claiborne's second case, aged nine years, had never been able to read. He was bright, smart, and alert. He comprehended words and sentences perfectly when spoken, knew common objects and their uses, but the moment he was set to looking at printed words or written dictation he became confused and showed all signs of shyness and lack of self-confidence. He recognized letters without error, but when put together to form words the difficulty began. The word "how" he read "you." The word "are" he called "ray"; "made" he called "ham," or again "man."

The word "Herbert" he wrote from dictation, letter by letter, "Herbdred," and called it "Purram." "Anna" he called "Ed." He made figures accurately, knew them all, and did some small sums in addition and subtraction as quickly as any child of his age could.

Dr. Claiborne did not believe there was any sign of motor aphasia in this case, because, although he wrote at dictation imperfectly, the letters of his writing were all correctly made, but improperly put together. They never degenerated into a scrawl, either meaningless or irrecognizable, as is common with motor aphasics when they write spontaneously or at dictation. His vision was normal, his fields also, and he was right-handed. The significant and peculiar fact in the case was that although the boy could recognize letters, the component parts of a word, and could pronounce each letter in each word, when he had finished he could not, except with several well-known words, such as "cat," "rat," and "dog," make the sound which the combination of letters really warranted.

Dr. Claiborne thought that in the second case the prognosis was good, for it seemed probable, if individual letters could be

remembered, words which were composed of letters should be remembered, under repetition, and this prognosis was all the more supported by the present method of instruction in vogue in public schools at least, the method of teaching children to read by looking at words and recognizing them as a whole. In short, the matter seemed to reduce itself to a repetition of impressions upon the cerebral cells. Since the boy was right-handed, the lesion probably was on the left side and in the angular gyrus.

Dr. Claiborne believed that figure amblyopia was the explanation of the inability of some people, intelligent and logical in other respects, to understand symbolic mathematics. The memory, of course, was the basis of it all, as it is the basis and commencement of every intellectual act.

In regard to the training of these children, when cases of this description are observed, Dr. Claiborne believed that they should be carefully differentiated, and similar cases should be grouped together. Methods of teaching should then be instituted to awaken the torpid cells into normal activity, if possible, and if this was found to be impossible to get the best attainable results, and he believed that the basis of the instruction should be repetition. So long, however, as these cases were not intelligently recognized, classed together, and properly instructed, so long should we fail to get the best results in these abnormal children.

In the discussion of these two papers which followed, Dr. CLAIBORNE thought that the average boy had figure amblyopia. Many boys complained of their arithmetics. Repetition and patience were required.

Dr. LINN EMERSON thought that the cases of inveterately bad spellers were cases of word amblyopia. He had known a well-marked case in a well-educated man of marked business ability.

Dr. A. SCHAPRINGER thought that English spelling was more responsible for these cases than that of any other language. Almost all the cases reported had been reported by English surgeons. Wernicke's cases, however, spoke Spanish, an easy language in regard to spelling.

But Dr. Schapringer had no doubt but that there were more cases in English- than in German-speaking people.

Dr. CLAIBORNE thought that the cases were more common than was generally supposed. In instruction, the cultivation of left-handedness in these cases might be of service.

Dr. GEO. S. DIXON read a paper entitled **on the localization of foreign bodies in the eye and orbit, with lantern-slide illustrations.**

Dr. Dixon employed for this purpose his own modification of the MacKenzie-Davidson apparatus, which has already been described in the ARCHIVES OF OPHTHALMOLOGY, vol. xxxiv., No. 3, 1905.

This modification he had subsequently improved upon. The full description of his most recent apparatus will be found in the *New York Eye and Ear Infirmary Reports* for the year 1906. The most important points are the following: Instead of a ball with a set screw, he now employs a split sleeve to which the indicator is attached. The sleeve has a sufficient amount of friction to hold it in position, and is not disarranged as the old form was likely to be during attempt to set the screw. A second instrument has been devised for the purpose of squaring the head. Dr. Dixon states that unless the head is correctly placed so that it will be in the same position in reference to the plate as the plate should be in reference to the chart on which the location of the foreign body is to be plotted, errors are likely to occur.

Dr. WILLIAM M. SWEET of Philadelphia agreed with Dr. Dixon upon the importance of an early examination by the X-rays in all cases of ocular injury by foreign bodies before the magnet is employed. Since the different methods of localization were all based upon the same principle of triangulation of the foreign body at two exposures, he thought the accuracy in the results depended largely upon the skill of the operator. In the localizing apparatus which he has employed for the past ten years, two indicating rods were used, the displacement of the shadow of the second indicator on the plate in reference to the first indicator permitting the operator to determine the source of the X-rays at each exposure with great accuracy. He thought that with two indicators there was less liability to error than when only one indicator was used. Dr. Sweet referred to the variations in the size of the adult eyeball from errors of refraction or normal causes, and the importance of this difference in the situation of bodies localized at the posterior part of the full-sized globe.

Dr. E. GRUENING thought that the more of this work one did the more accurate would he become.

Dr. J. E. WEEKS thought the indicator of Dr. Dixon rather better generally than that of Dr. Sweet.

Fig. 1.

Kgl. Univers. Druckerei v. H. Stürtz, Würzburg. Verlag v. J. F. Bergmann, Wiesbaden.

Fig. 2.

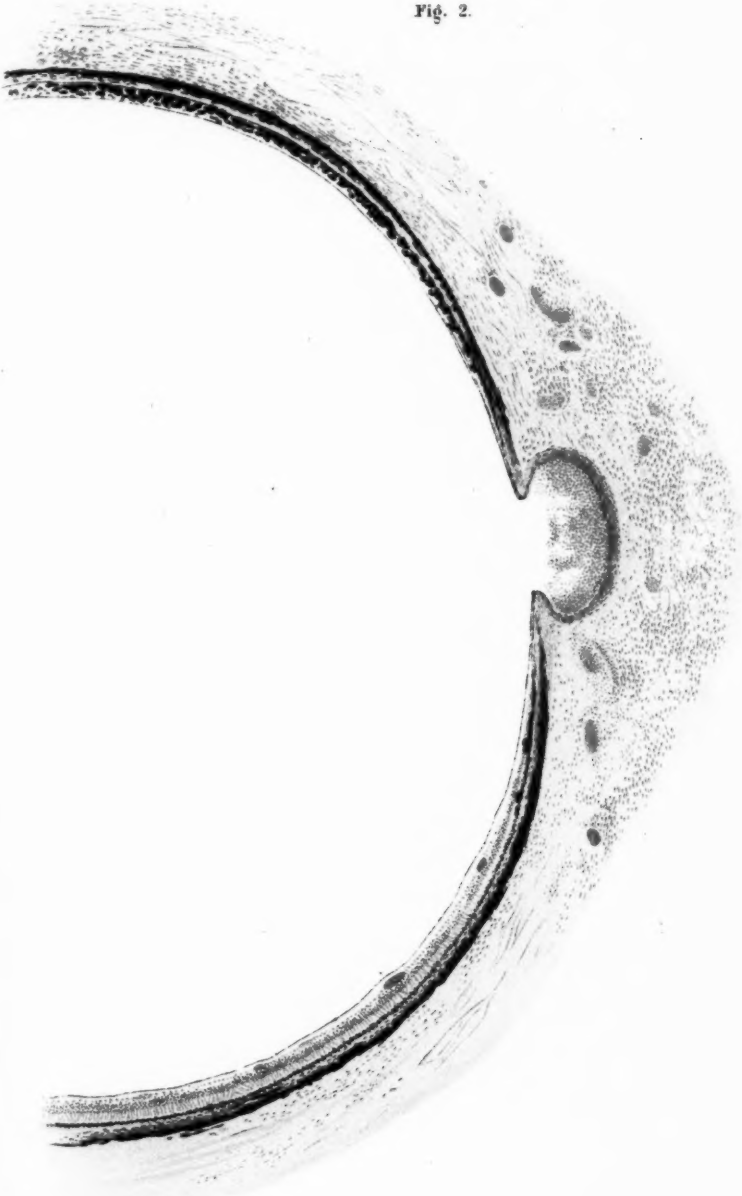

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Fig. 3.

Kgl. Hofen-Druckerei v. H. Stürtz, Würzburg. Verlag v. J. F. Bergmann, Wiesbaden

Fig. 4.

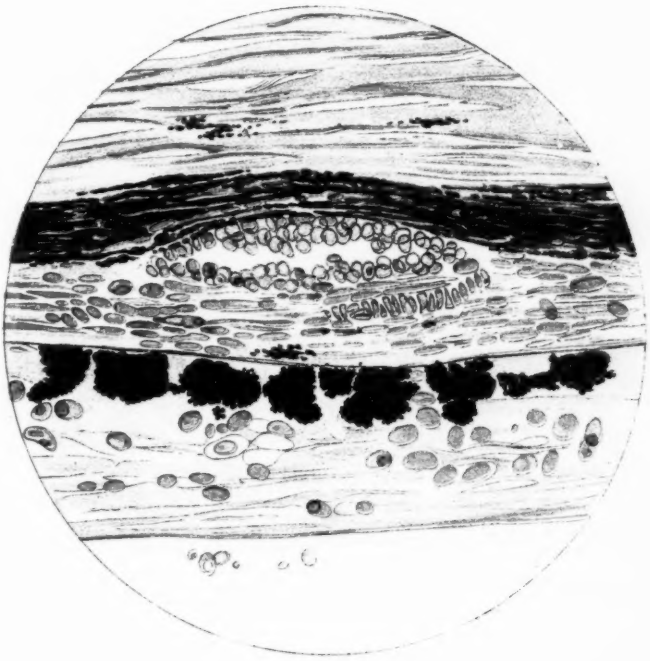

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Fig. 5.

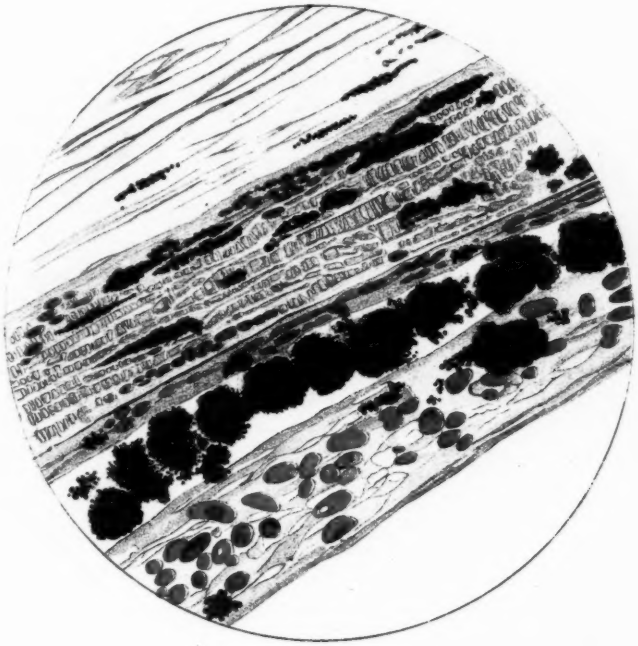

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Fig. 6.

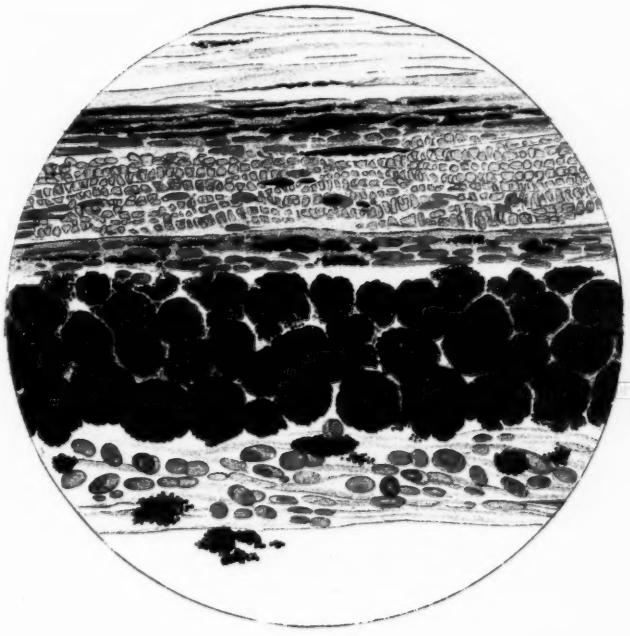

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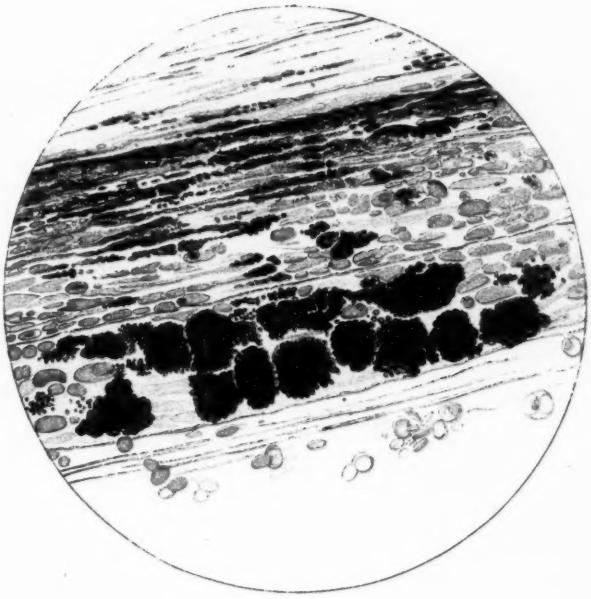
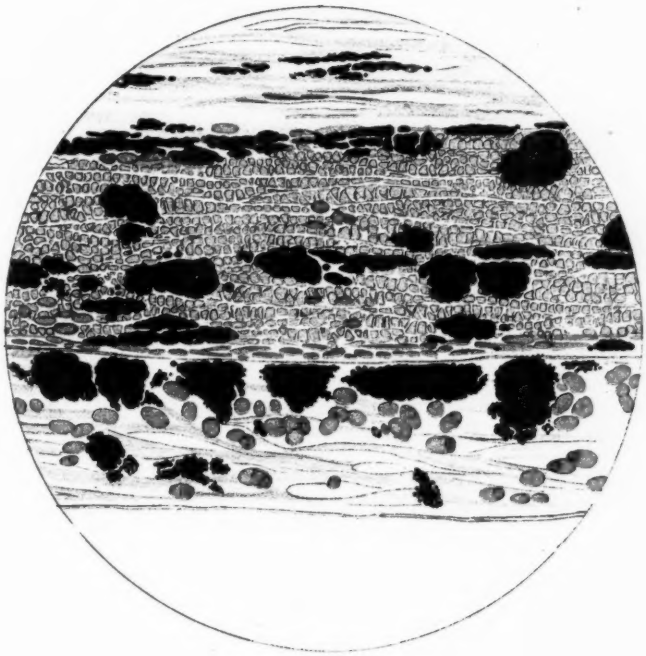
Fig. 7.



Kgl. Hofbuchdruckerei v. H. Stürtz, Würzburg. Verlag v. J. F. Bergmann, Wiesbaden.

Fig. 8.



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